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Wiring $30 million Portland, Ore., business and shopping center. Page 83.

Electrical system rewiring to serve a modern data processing center. Page 88.

Bus risers solve new power capacity problems in hotel rewiring. Page 101.

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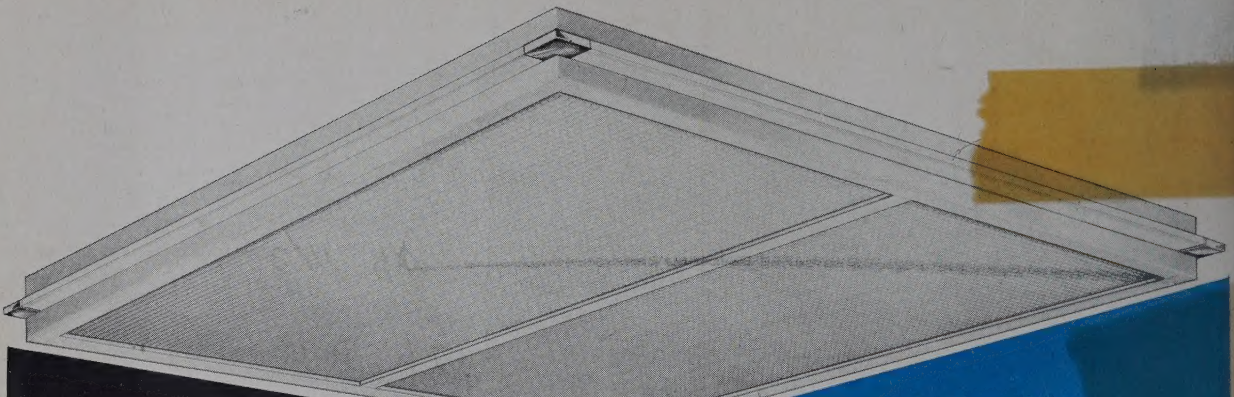

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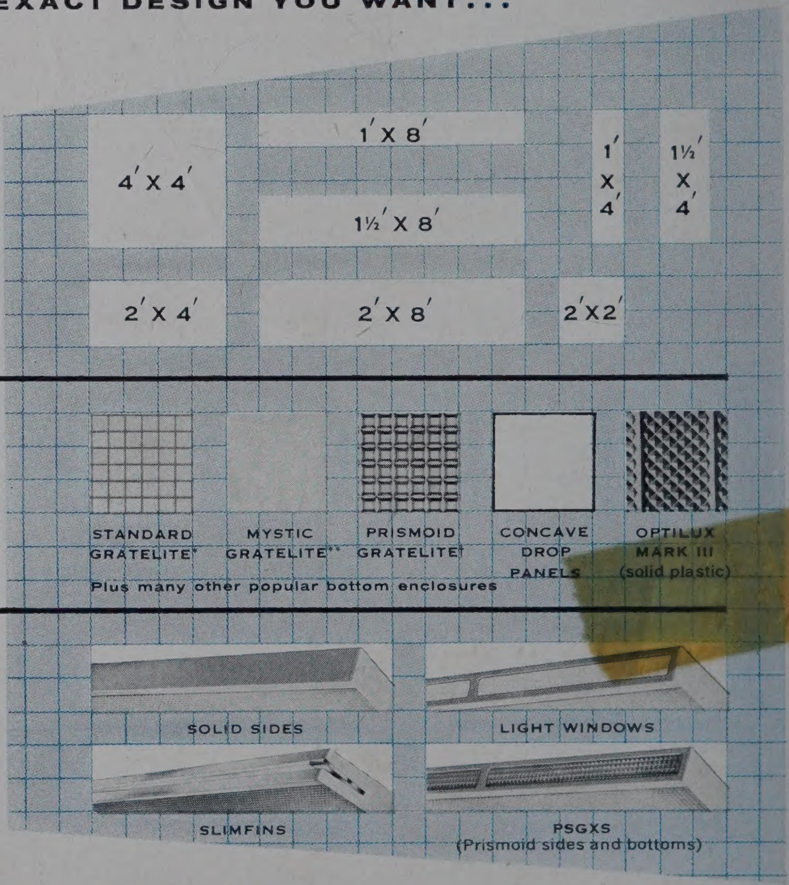

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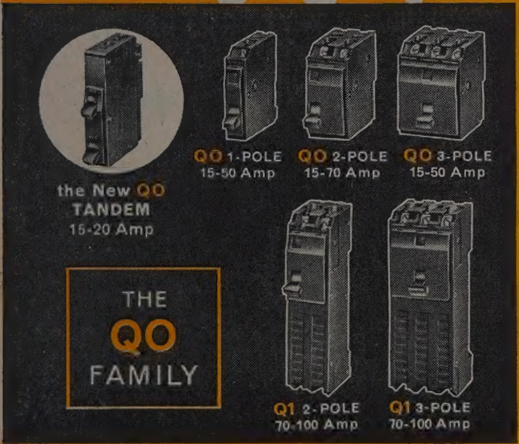

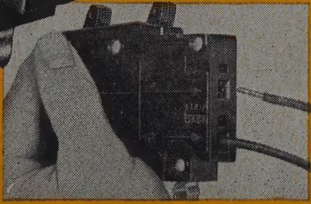

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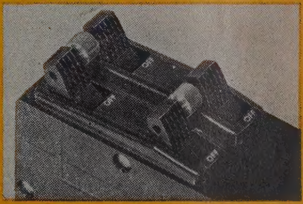

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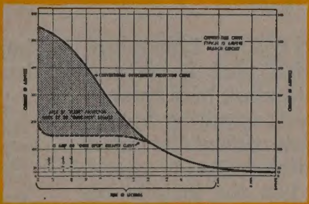

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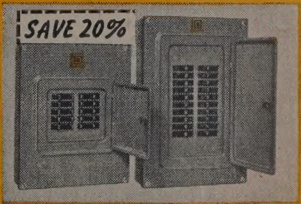

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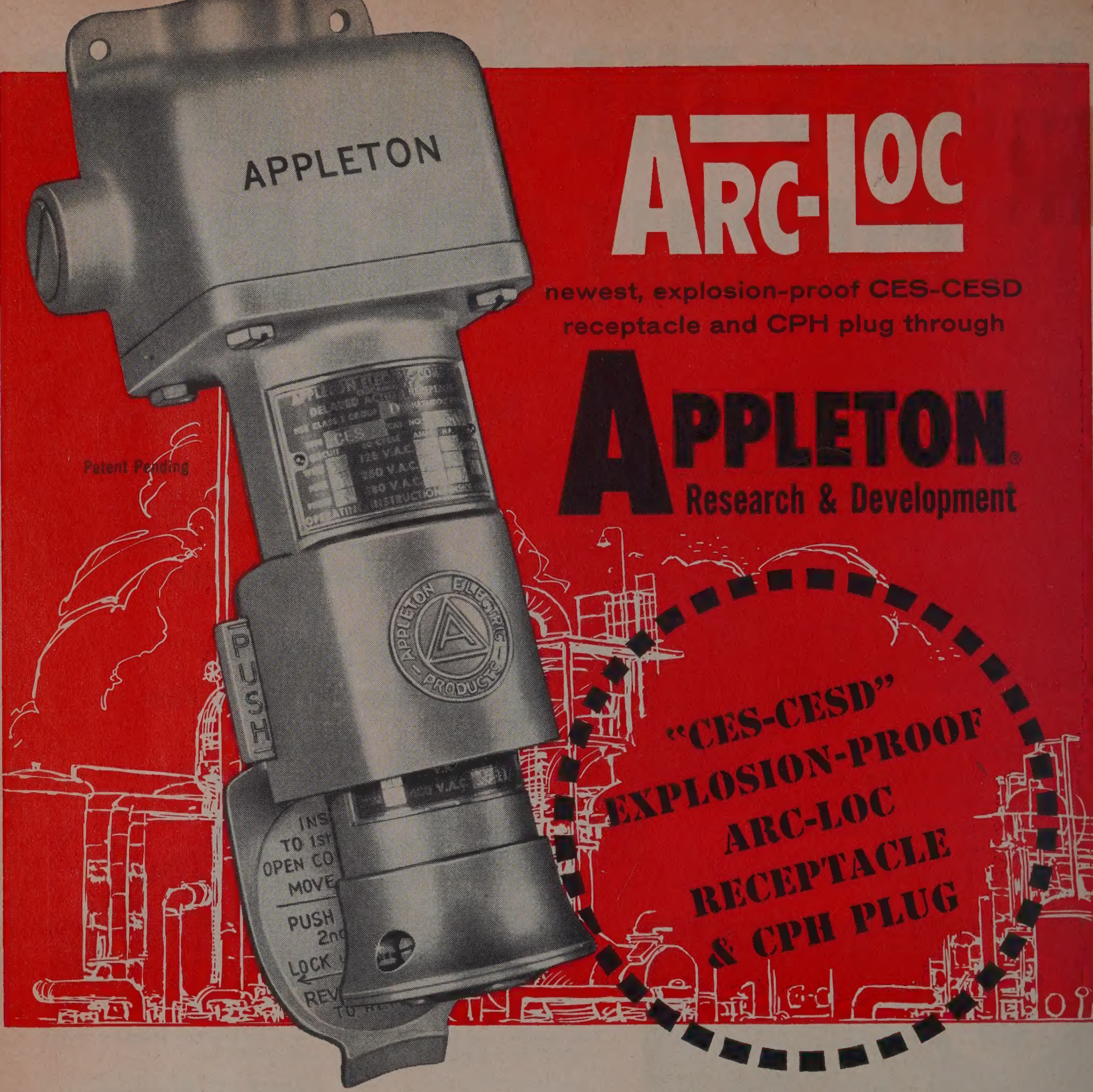
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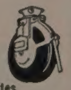
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ELECTRICAL CONSTRUCTION AND MAINTENANCE

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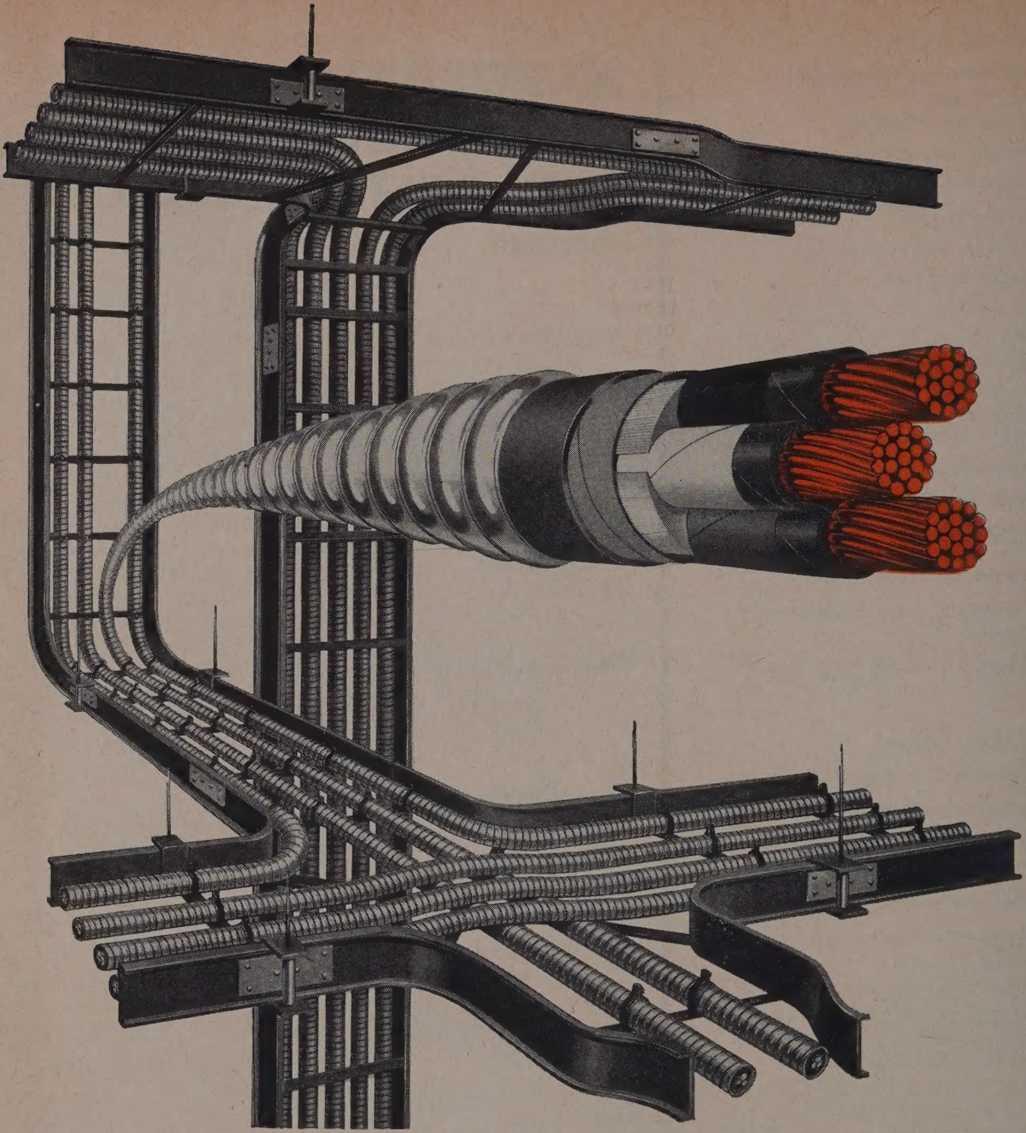

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Sidelights

NON-INTERCHANGEABLE BREAKERS

One of the most-discussed Code compliance issues of the day promises to be the new rules pertaining to the non-interchangeability of circuit breakers in lighting and appliance panelboards. Originally scheduled for a July 1960 compliance deadline, effective date has been extended to January 1961 in many areas when breakers of 20-amp capacity and under will thereafter be installed in such a manner that they cannot be replaced with breakers of higher rating. Products designed to satisfy the new rules are expected to be generally available to the trade in time for the new deadline.

NEW 14-BUILDING CENTER

Wiring for a 14-building, $30-million, business and shopping center in Portland, Ore., takes three 11.8 kv primary services to seven substations and extensive secondary busway systems for a total initial load of 20,000 kva. Details of the distribution system layout and installation are described in this issue by Clifton Tingley, Project Superintendent for the electrical contractors, Lord Electric Company of Portland. The article "Mile Long Bus Complex," begins on page 83.

CARNEGIE LIBRARY MODERNIZATION

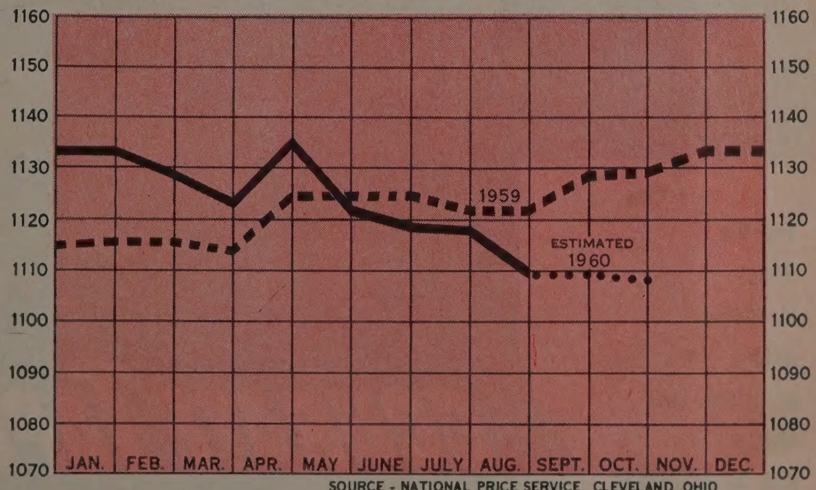
Electrical modernization of a famous monumental building presents special problems in incorporating the new electrical work and equipment to conform appropriately with existing architectural features. The Carnegie Library and Museum in Pittsburgh, Pa., built at the turn of the century, presented a particularly interesting challenge in electrical rebuilding because it also involved a changeover from its own steam driven dc supply to purchased ac power. Joseph T. Danko, Consulting Electrical Engineer, Pittsburgh, Pa. describes the rewiring project in "Rewiring Highlights at Carnegie Museum Library," beginning on page 122.

ELECTROLUMINESCENCE

Application of electroluminescent lighting methods are now being considered for highway signs. The new lighting source promises low power consumption, long life, easy maintenance, comfortable brightness and excellent background contrast. A practical test installation has been erected near Sacramento, Calif., by the California Division of Highways. Details of the construction and installation are reported in "Electroluminescence—for High Speed Readability" beginning on page 96.

ELECTRICAL MATERIALS COST INDEX

BASE LINE (1000) REPRESENTS COSTS OF TYPICAL ASSORTMENT OF MATERIALS FOR A SELECTED JOB AS OF NOVEMBER 1, 1951. INDEX POINTS REPRESENT THE VARIATION OF THESE SAME MATERIAL COSTS AS OF THE FIRST OF EACH MONTH.



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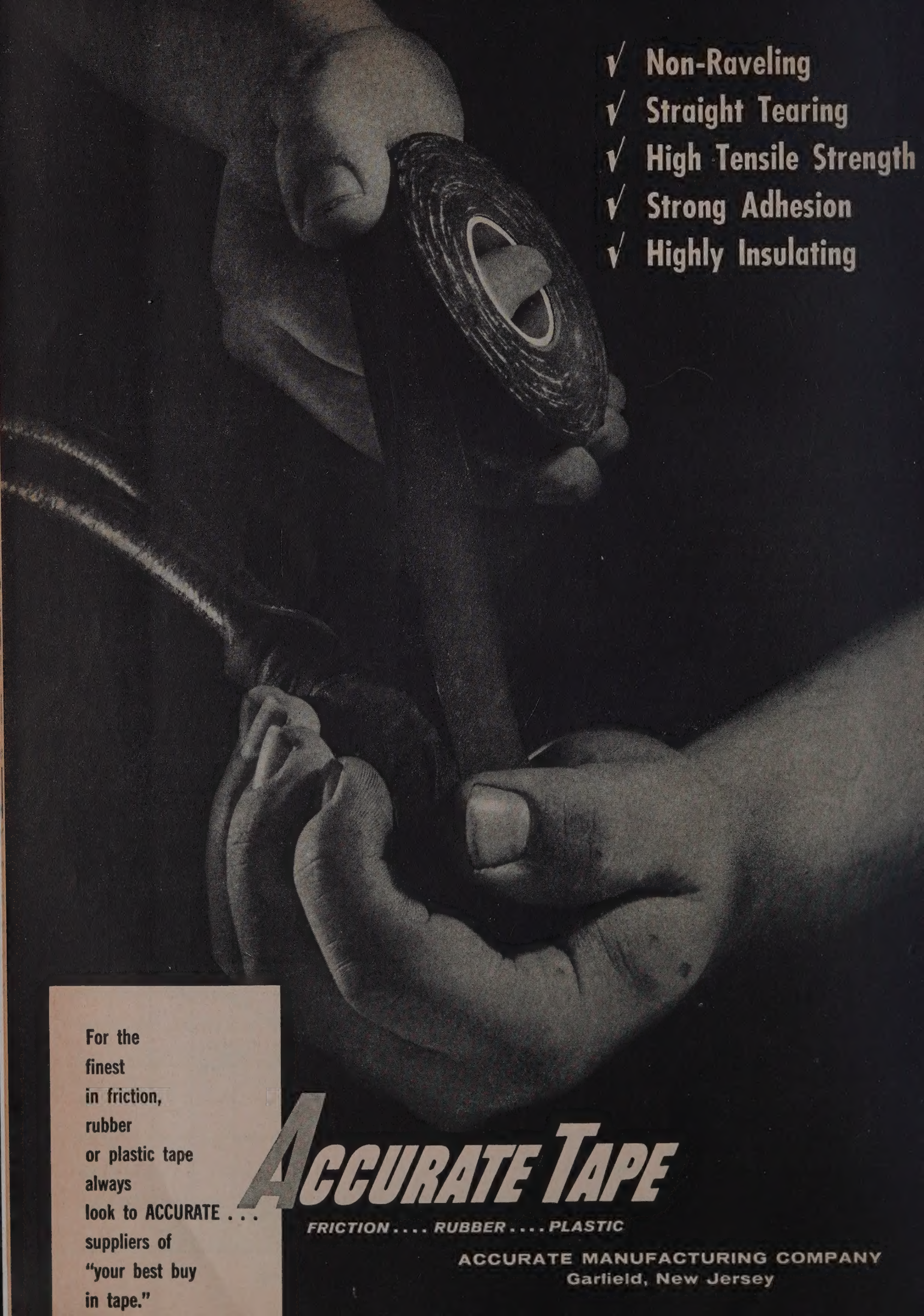

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OCTOBER • 1960

Total business volume will continue at its record level through the 4th quarter, and for 1960 as a whole will probably set a new record. Some key segments of business, however, have declined considerably, while other segments have continued to move along at a high and even ascending level.

Much of the current business pessimism results from the skid taken by steel, from near capacity in January to little more than half capacity at present, and from the decline in housing starts, which started in mid-1959, and slid from an annual rate of over 1.5 million in July 1959 to 1.2 million in July of this year.

On the optimistic side, Gross National Product last quarter was running at an annual rate of about $507 billion, $2 billion more than in the 2nd quarter, and about $26 billion higher than at the same time a year ago. Total personal income in August, at an annual rate of $407.6 billion, was the highest for any month on record. And industrial production in August was 109% of the 1957 average, and only two points below the all-time record of 111% in January of 1960.

The national economy as a whole has been experiencing a "rolling readjustment"—some things up, some things down. The sum of the readjustments has been a high plateau "status quo," without the additions of normal growth patterns. On balance, any pickup in steel production and in residential construction will reflect just that much growth in the currently static economy.

Retail sales in August totaled $18.2 billion, same as for July, but down $100 million from August of last year. Total outstanding consumer credit at the end of July was $53.7 billion, up $5.6 billion from the year before. This consisted of $41.7 billion of installment credit, and $12 billion of non-installment credit. The increase in installment debt in July was $249 million above the month before, the smallest monthly increase since November 1958. Consumers, with more money to spend, have been cautious buyers, now need more money for rising costs in education and for higher medical bills.

Use of electricity soared to a new record of 14,941 million kwhr in the week ended Sept. 3, up 8.6% from the similar 1959 week, EEI reported. All regions recorded gains, ranging from 3.2% to 15.3%.

Factory workers can buy 40% more with their earnings today than they could in 1947, Dept. of Labor reports. Production-worker paychecks have increased by 80% over the past 12 years, but increases in the cost of living have limited increases in purchasing power to half that figure.

Spending for new construction declined in August for the third consecutive month, after allowing for seasonal trends. Actual value of new construction put in place in August was nearly $5.2 billion, approximately the same as in July. Construction outlays for the first 8 months of 1960 were $35.5 billion, about 3% below outlays in comparable period of 1959.

The decline in new construction stems from the sharp slide in homebuilding over the past 16 months. Housing starts in August were 127,400, up slightly from 115,000 starts in July, but down sharply from 142,400 in August 1959.

Census Bureau reports 58.6 million housing units in the inventory this spring, up from 46.1 million in 1950, and a vacancy rate of more than 7%, nationwide. While many of the existing houses are substandard, the slight surplus, plus today's high cost of building, is considered responsible in the main for the current slowdown in the purchase of new homes.

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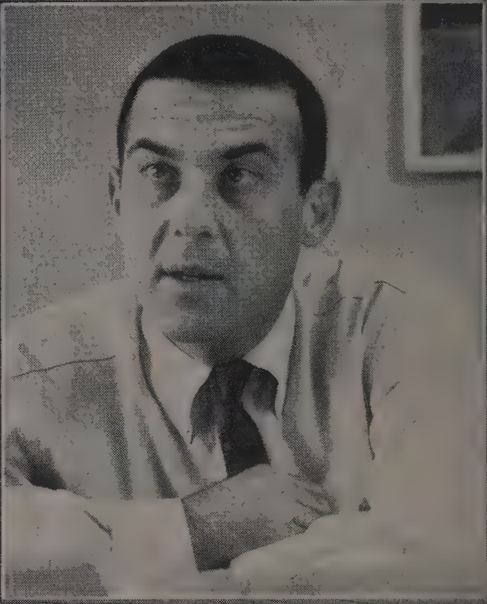

"I've been using concealed telephone wiring in my homes for the past eight years, so obviously I'm sold on it," says builder Alan Schwartz. "It's a good investment . . . a real sales advantage."

Mr. Schwartz builds custom homes ranging from $28,500 to $48,500. Every one of them has provision for several telephone extensions. "The cost is nominal," says Mr. Schwartz. "And customers are impressed with the amount of planning that goes into the house—the attention to detail.

"Concealed telephone wiring and extra outlets aren't just added luxuries," says Mr. Schwartz. "We do a lot of slab work here in California. That gives us no crawl space. And with so much open-beam living in addition, built-in telephone wiring becomes a *must.* The less expensive the house, the less opportunity to work in concealed wiring *after* construction."

* * *

Your local Telephone Business Office will gladly help you telephone-plan your homes. For details on home telephone installations, see Sweet's Light Construction File, 11c/BE. For commercial installations. Sweet's Architectural File, 34a/Be.

BELL TELEPHONE SYSTEM

California homes such as this Schwartz model in San Fernando Valley stress outdoor living. Note circled patio outlet for convenient portable phone with plug-in jack.

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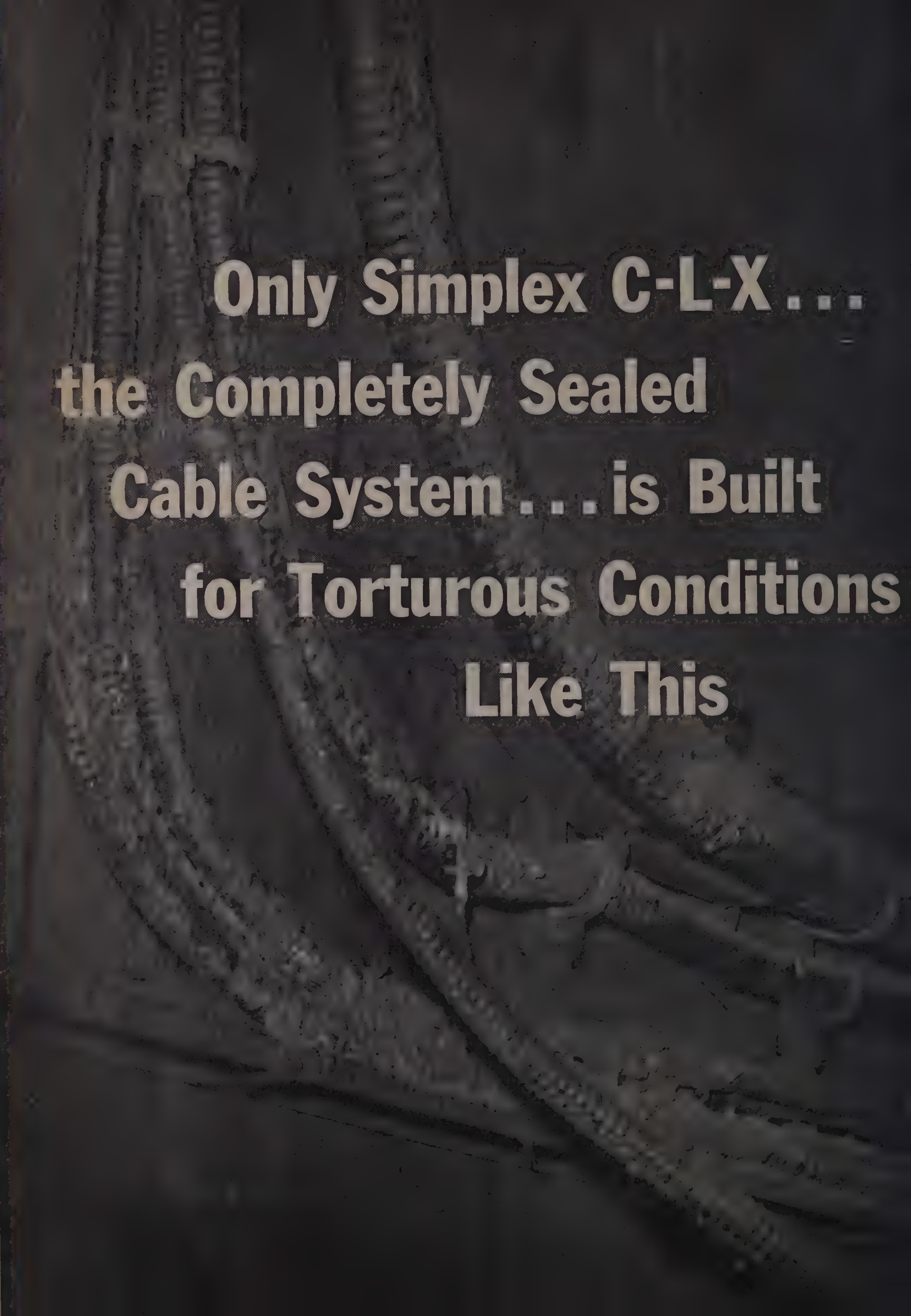

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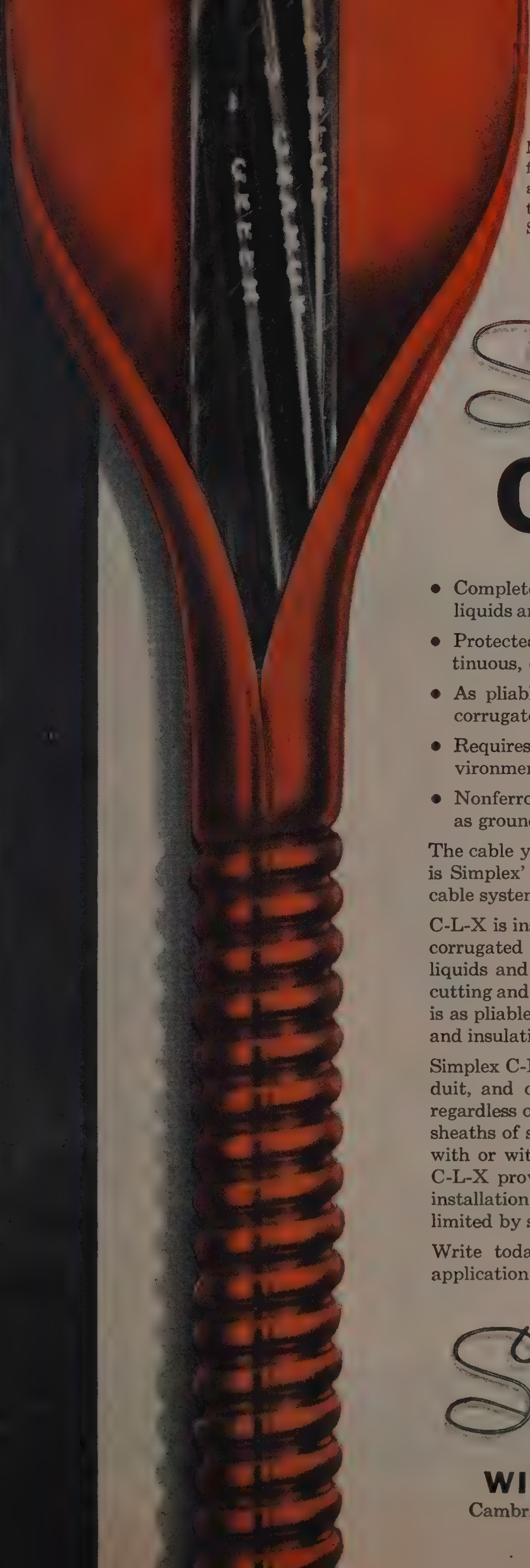

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RIGID ROPE

Pat. Pending

Replaces Fish Tape!

FISH ANY SIZE, ANY TYPE CONDUIT *SAFER, FASTER and for LESS COST!*

- Non-conductor—braided poly jacket over solid poly core.
- Flexible—easy to push, easy to grip, won't "spring" out of hand, glides easily through conduit.
- Durable—can't rust, won't separate, strong, long-life, rugged.
- Lightweight—weighs only 14 oz.
- 50' and 100' Lengths—costs less than any fish tape designed for use in all types of conduit!

"Guide Sleeve" of polyethylene, 12" length, included—for use in feeding Jet Line RIGID ROPE into outlet boxes.

Use JET LINE® RIGID ROPE and do away with metal fish tapes!

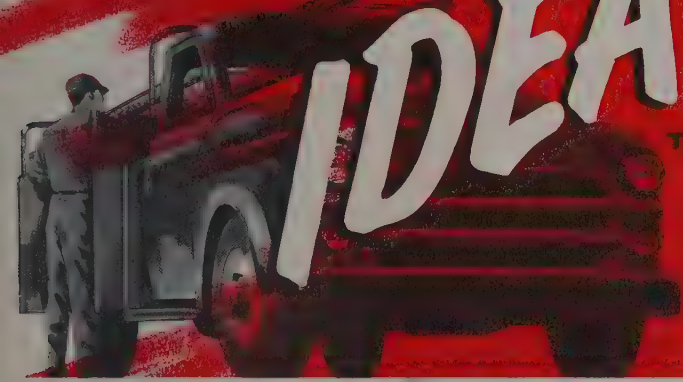
4940

JET LINE PRODUCTS, INC.

615 FUGATE AVE., CHARLOTTE 5, NORTH CAROLINA

HERE IT IS!

GraybaR's NEW IDEA BOOK



O

TIME-AND-MONEY-SAVIN

TO BRING YOU UP T

ELECTRICALLY...

and prof

Beat corrosion and handling problems with TRIANGLE Hot-Dip Galvanized Rigid Steel Conduit!

Triangle Hot-Dip Galvanized Rigid Steel Conduit is completely protected, inside and out, with a heavy, uniform, hot dip coating of zinc . . . *including* the threads. Since nothing is left uncoated, there is no place for corrosion to start.

Because it is hot-bonded permanently to the conduit, the zinc will not flake, despite rough handling, crushing or bending. In addition, a durable, bichromate finish prevents oxidation and white rust, assuring long life. For complete catalog information, showing sizes, couplings and other accessories, circle number 1 on the Graybar postcard.

TRIANGLE CABLE AND CONDUIT COMPANY

Save Dollars on conduit wiring with the New JET LINE GUN!

Here's an all-new Jet Line Gun that lays a strong nylon line through large-size pipe up to 600 feet *in seconds!* You save *hours* on every large job . . . hours that will pay for the Gun and Kit in short order. What's more, the new model costs only one-third as much as the former model!

A self-propelled cartridge, to which you tie the nylon line, does the job. Your Jet Line Kit comes complete with Gun, nylon line and can, cartridges, extra line, nose cone extensions, entrance adapter and extra needles. For complete information about the Jet Line Gun—and the Cylinder system for small conduit—circle number 2 on the Graybar postcard.

JET LINE PRODUCTS, INC.

NEW! C-L-X
completely sea
system by SI

The cable you see here is
armor, but Simplex' new
cable system that's co
against liquids and gase
against mechanical dama
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it is as pliable as unshe
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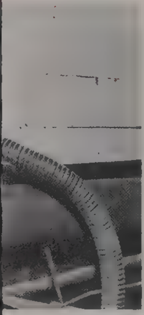

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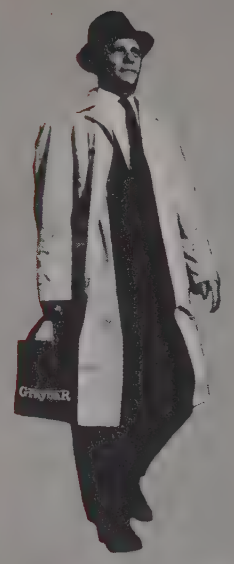
on the Graybar

CABLE CO.

ANOTHER GRAYBAR TEAM MEMBER TO HELP YOU!

You've always had the Outside Salesman . . . the Inside Salesman . . . the Specialist . . . and the Counterman . . . on the Graybar team, ready to go to work for you whenever you need them. Now, here's something new—at your service immediately. To help you get complete information on the products shown on these pages, simply circle the appropriate numbers on the Graybar postcards below (the extra one is to give to someone else in your organization) and drop in the mail. We'll get you what you want and send it by return mail. Fill out the card today!



OUTSIDE SALESMAN

INSIDE SALESMAN

SPECIALIST

COUNTERMAN

DETACH AND MAIL CARD TODAY

DEPT. QEC

Gentlemen:

Thanks for your offer. Please send me the literature covered by the numbers I've circled below:

1	2	3	4	5	6	7	8	9	10	11
12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30	31	32	33
34	35	36	37	38	39	40	41	42	43	44

NAME____________________ TITLE__________

FIRM______________________________

ADDRESS___________________________

CITY______________ ZONE____ STATE__________

DETACH AND MAIL CARD TODAY

DEPT. QEC

Gentlemen:

Thanks for your offer. Please send me the literature covered by the numbers I've circled below:

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nder 25-foot head

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XE and TX expan-
e all described and
our literature. For
number 9 on the

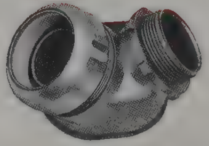
item ... mail card to GraybaR!

Light! Versatile! Dependable! "TOLEDO" No. 68 Power Drive

The ideal, lightweight, portable power drive . . . adaptable wherever power is needed for pulling, lifting, cranking, turning. Basically, it consists of a worm and ring gear assembly powered by a reversible ½-hp motor. Strong, lightweight frame, the No. 68 "TOLEDO" Power Drive weighs only 33 lbs. Adaptors may be fitted quickly for many different jobs. It takes die stocks up to 4"—works equally well with hand or geared die stocks. The No. 68 is the handiest tool a mechanic can own. It's the tool of a dozen uses, in the shop, or on the job. For complete information, circle number 10 on the Graybar postcard.

TOLEDO PIPE THREADING MACHINE CO.

ANOTHER DURO FIRST!



New 90° Liquid-Tight Pull Corner Elbows, for use with Liquid-Tight Flexible Conduit. This fitting has a removable cover for easy, straight, wire pulling. No more having to pull wire around a corner.

These fittings have many applications; make work go easier and faster. Want complete details? Then circle number 11 on the Graybar postcard.

DURO FITTINGS COMPANY

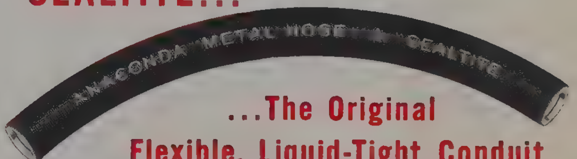
For fingertip safety... FEDERAL PACIFIC A-plus Safety Switches

Triple protection and fingertip operation! Exclusive with Federal Pacific's Type *A-plus* industrial safety switch. Visible blades *plus* the high current capacity of a circuit breaker *plus* the high interrupting capacity of fuses. And, it's rated for load break, not just disconnecting duty. Fingertip operation with quick-make, quick-break mechanism.

Federal Pacific heavy-duty industrial safety switches are available in 30 through 1200 amp ratings, 250 and 600 volts. Bulletin 1241 gives you all the specs; circle number 12 on the Graybar postcard.

FEDERAL PACIFIC ELECTRIC COMPANY

SEALTITE®...

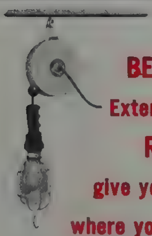


...The Original Flexible, Liquid-Tight Conduit

Sealtite protects wiring from moisture, chemicals, abrasion, vibration, etc. It's ruggedly constructed with a flexible galvanized steel core, over which is extruded a polyvinyl chloride cover. Available in three colors: black, gray and white. Sizes from ⅜" through 4". Underwriters' Laboratories listing for Type UA.

For a detailed brochure describing Sealtite, an Anaconda product, and the liquid-tight connectors that are also available, circle number 13 on the Graybar postcard.

ANACONDA METAL HOSE DIVISION
ANACONDA AMERICAN BRASS COMPANY



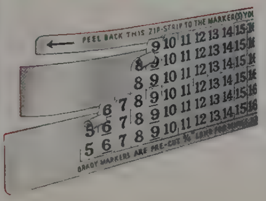
BENJAMIN Extension Cord REELS give you current where you want it!

Enjoy the convenience of a Benjamin Extension Cord Reel to bring your current where you want it, when you want it. Available with ceiling, wall or junction box mounting, with or without trouble light. Up to 50 feet of wire, 16 or 18 ga., 2 or 3 conductors. High-impact, oil-resistant plastic handle. Trouble light comes with tool tap, switch and guard.

For complete literature showing the features of Benjamin reels, circle number 14 on the Graybar postcard.

BENJAMIN REEL PRODUCTS, INC.

BRADY can save you 50% marking small-gage wires!


PEEL BACK THIS ZIP-STRIP TO THE MARKER(S) YO
5 6 7 8 9 10 11 12 13 14 15 16
BRADY MARKERS ARE PRE-CUT ¾"

Brady pressure-sensitive, all-temperature wire markers for small-gage wires are exactly ¾" long, to fit wires under ¼" O.D. They cut your small-gage wire marking in half because: (1) they cost half the price of standard markers, and (2) they go on the wire twice as fast! What's more, they stick and stay stuck at temperatures up to 300° F.

Over 3000 stock markers are available. Send for your copy of our big new bulletin and free testing samples today. Circle number 15 on the Graybar postcard.

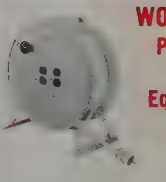
W. H. BRADY CO.

New from BERNZ O MATIC Double Value Carry-All Torch Kit!

Here's a complete Bernz-O-Matic Torch Kit, with METAL carrying case, and at just about half the usual price for the kit alone! Perfect for almost every job requiring quick, intense on-the-spot heat. The carrying case gives you plenty of room to add your tools from your own workshop plus solder, flux, etc.

You'll save plenty of time and money with this kit. Complete information on the line of Bernz-O-Matic equipment can be obtained by sending the Graybar postcard. Circle number 16.

OTTO BERNZ CO., INC.



WOODHEAD Portable Power Equipment

Makes your job easier...safer!

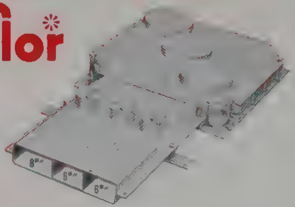
Rely on "Safety Yellow"—the sign of Woodhead safety power equipment. For example: The #910 Portable Cord Reel that places four live, safe receptacles at your work area—handles up to 375 feet of cord. Or, the #3000 series Outlet Boxes that permit installation of standard receptacles of your choice in Safety Yellow Neotex boxes—provide as many outlets as you need for the job.

Send for free literature covering all the famous Woodhead "Safety Yellow" products. Circle number 17 on the Graybar postcard.

DANIEL WOODHEAD COMPANY

For more information on any

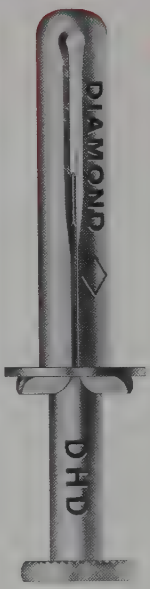
For versatility, adaptability and economy—specify Conduflor* 3-Cell Underfloor Distribution System!



Versatile: For slab-on-grade; slab-and-fill; monolithic pour. Requires minimum depth of just 3½ inches. Adaptable: Three cells for any combination of systems—power, telephone, signalling, intercom, what have you. And economy: No increase in cost over conventional methods. Laid 30 feet at once on standard 10-foot lengths. Compare labor vs. material costs and see for yourself.

Not that we expect *you* to do everything! For example, we've prepared a brochure which gives you complete specs, installation methods, schematics, typical layouts, etc. Get yours free . . . circle number 18 on the Graybar postcard.

CONDUFLOR CORPORATION



Speed brick and masonry anchoring with DIAMOND DHD® HAMMER DRIVE ANCHORS!

Save time and expense installing conduit, junction or fuse boxes, underground power cables, ductwork, etc. Use speedy, safe and secure Diamond DHD® Hammer Drive Anchors. Installation is really fast: just drill hole, insert anchor and drive nail. Each unit comes complete with forged aluminum anchor and hot galvanized nail. Sizes: 3⁄16" x 7⁄8" to ½" x 3½".

We'll be glad to send you complete instructions on the use of DHD anchors, as well as free samples and information on both rotary and percussion-type carbide-tipped masonry drills. Circle number 19 on the Graybar postcard.

DIAMOND EXPANSION BOLT CO., INC.

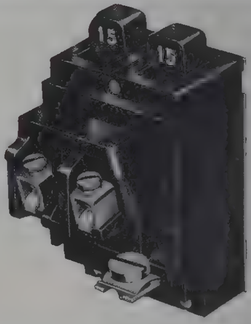
BULLDOG's new Duplex Pushmatic®...

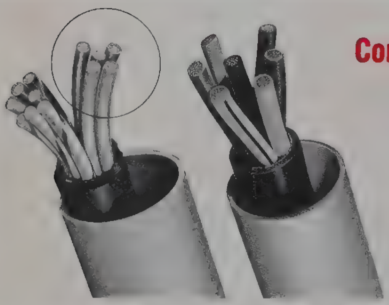
The only space-saving breaker with Coil-Magnetic protection!

Our brand new edition of the Pushmatic Pocket Guide is now ready; 72 pages of catalog and installation specifications for the complete Bulldog line of breakers and panels. Get yours now! Circle number 20 on the Graybar postcard.

- Two circuits in one compact unit
- Identical solenoid magnetic coil protection for both 15- and 20-ampere circuits
- One single, positive, bolted connection to bus bar
- Famous ***Pushmatic pushbutton*** convenience

BULLDOG ELECTRIC PRODUCTS DIVISION
I-T-E CIRCUIT BREAKER COMPANY





Control Cable Savings Begin with ROCKBESTOS PNR Small Diameters!

Both conduits shown here are 1¼" D. The conduit on the left carries 12-conductor PNR #9 AWG—5 more conductors than conventional 7-conductor #9 AWG cable on the right. Rockbestos PNR is 46% smaller in area than conventional control cable—permits almost double existing conduit conductor capacity—saves on smaller size conduit, fittings and weight—cuts installation costs.

Our new Control Cable Conduit Fill Chart gives you complete instructions, sizes and other specifications for both new work and re-wiring. For your free copy, circle number 21 on the Graybar postcard.

ROCKBESTOS WIRE & CABLE CO.

Specify CAPEWELL—for precision Hack Saw Blades and Hole Saws!

Capewell hack saw blades and hole saws are made from special alloy steels under continuous quality control for absolute assurance of precision setting and uniformity of teeth. Electronically controlled tempering further guarantees maximum cutting efficiency and life. For complete details on Capewell blades and hole saws, circle number 22 on the Graybar postcard.

CAPEWELL MANUFACTURING CO.

The finest step ladder on the market: BABCOCK's "Mechanics' Step"!

And we're not the only ones who feel this way! Electrical contractors demand this superb ladder because:

- BABCOCK means QUALITY!
- Long life means fewer replacements, cheaper in the long run!
- Moderate price despite its high quality!

There's a right ladder for every job—and Babcock's new brochure helps you select the right one each time. For your free copy, circle number 23 on the Graybar postcard.

W. W. BABCOCK CO., INC.

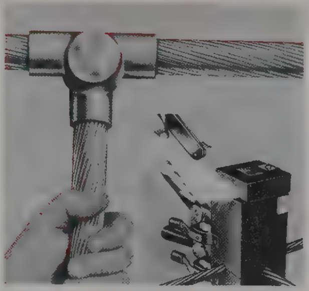
item...mail card to GraybaR!

Connect flexible conduit faster and tighter with APPLETON "STN" Sealtite Connectors!

The fastest, most economical and trouble-free method yet devised for making liquid-tight, flexible conduit connections is yours with the new Appleton "STN" Sealtite Connectors. Exclusive wedge adapter provides a "cold-weld" seal that *lasts*. You get a positive ground, and no ragged edges. Acetate-insulated throat protects wires without reduction of throat diameter. Installs with just one wrench!

Let us show you how you'll do better, faster work with these "STN" Connectors. Full literature is available on request. Circle number 24 on the Graybar postcard.

APPLETON ELECTRIC COMPANY



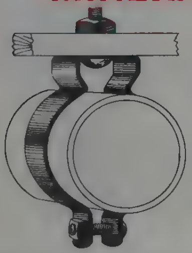
BURNDY THERMOWELD for PERMANENT electrical connections!

Weld anywhere—to cable or flat surface, copper or steel—with the compact, lightweight THERMOWELD. Completely self-contained . . . needs no external source of power, no special skill or experience. The Thermomold fits over connectors, clamping cable into position. Powder is poured in, fired, and the connection is complete. It's that simple. AND, it's permanent!

Hard to believe? Then see it demonstrated. Or, send for our brochure describing the complete operation and application of THERMOWELD. It's free. Circle number 25 on the Graybar postcard.

BURNDY CORPORATION

"MINERALLAC" —the ORIGINAL pipe and conduit hanger!



Often imitated, but never duplicated! Available for iron pipe or E.M.T. from ⅜" I.P. to 3½" I.P. in zinc-plated steel, Everdur alloy and aluminum. Available also for 4" I.P. in zinc-plated steel.

Quality-proved over the years, Minerallac Hangers far outlast ordinary hangers—prove more economical as the years go by. Get full information now—we'll be glad to send 4-page catalog giving complete specifications. Circle number 26 on Graybar postcard.

MINERALLAC ELECTRIC COMPANY

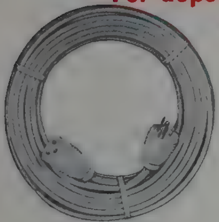
NEW UL-approved Wire Connectors from IDEAL

Here's a new Wire Connector with built-in wings that act like a wrench. Goes on tight and sure. And it stays tight, thanks to the inner resilient spring that maintains tension and compensates for thermal expansion. Tough Nylon shell for high dielectric and mechanical strength; permits visual inspection. Available in two sizes for #14 through #6 wires.

Try them free! Send for "testing samples" and our new six-page product bulletin. Circle number 27 on the Graybar postcard.

IDEAL INDUSTRIES, INC.

For dependable, trouble-free performance, install PWC Control Cables and Safety Cords!



PLASTIC WIRE & CABLE CORPORATION

Control cables must give trouble-free performance since they are applied to vital services. That's why contractors and maintenance men specify PWC! Each PWC cable is made with the specific characteristics necessary for the job it must do. And there's one for every purpose—small diameter, traffic signal and alarm applications, supervisory and station control, and flexible cables for machine tools and portable equipment. What's more, the same manufacturing care and quality material go into PWC extension cords. For portable electric tools, appliances, pumps and compressors, lighting equipment—you name it, and there's the proper PWC for the purpose . . . We'll be glad to send a catalog of the complete line—just circle number 28 on the Graybar postcard.

Portable . . . Compact . . . Convertible . . . WELLS metal-cutting Band Saws

Here's a compact, convertible band saw that provides the capacity you need, and at a modest price. Equipped with optional wheel handle unit, the Model 58-B becomes completely mobile . . . easily rolls from job to job. Use it as a horizontal cut-off machine (capacity: 6" x 10") or swing the head to upright position, install work table, and it's a utility vertical band saw.

Our literature will give you lots of other ideas on uses for the 58-B—ideas that will speed your work and save your back. Just circle number 29 on the Graybar postcard.

WELLS MANUFACTURING CORPORATION

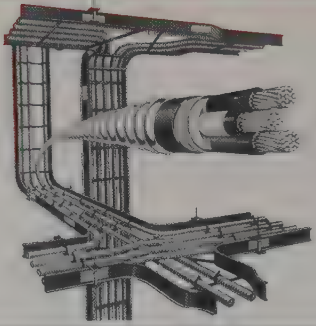
For more information on any

PHELPS DODGE ARMO-LOK CABLE (Type ACV)

The first to be listed by Underwriters' Laboratories

Phelps Dodge Armo-Lok (Type ACV) is the first varnish cloth insulated, PVC-belted, galvanized armored cable rated up to and including 5000 volts to be listed by the Underwriters' Laboratories, Inc. This cable offers a most efficient method of power distribution for industrial plants and utilities.

A new 14-page catalog showing all sizes, number of conductors, etc. for Armo-Lok Cable is now available. Contains all the information you need to specify. For your free copy, circle number 30 on the Graybar postcard.



PHELPS DODGE COPPER PRODUCTS CORPORATION

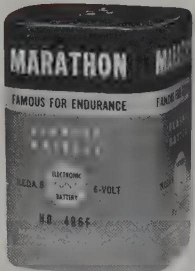
NEWEST CONCEPT FOR ANCHORING TO MASONRY RAWL SABER-TOOTH drills its own hole!

The new Rawl Saber-Tooth Masonry Anchor actually drills its own hole and provides many unique advantages in addition. Since it acts as its own drill, you get, in effect, a new sharp drill for each installation, with no drill expense. Also, it gives you "core" drill action for faster work. As an anchor, it expands deep in the masonry, where the masonry is strongest. Thus, it is unaffected by shock or vibration, it is fireproof, and exhibits an extremely high holding power.

Complete literature showing the wide range of sizes available, as well as instructions for use, is available upon request. Simply circle number 31 on the Graybar postcard.

RAWLPLUG COMPANY, INC.

Depend on MARATHON for all your battery needs!



You can't get a more complete line of dependable, durable batteries than MARATHON. One of the pioneers in the industry, Marathon combines developments of its own excellent engineering staff with technical assistance from some of the world's leading authorities on unusual battery problems and applications. The result is a line of batteries including standard 6-v dry cells and heavy-duty models for flashlight and lanterns, special 12-volt batteries for toys, radios, etc., and unique "Flasher" batteries for warning blinkers and lanterns, all designed for the longest possible life consistent with the application. Famous for endurance! The complete line of both standard and special model batteries is described in our free catalog. For your copy, circle number 32 on the Graybar postcard.

MARATHON BATTERY COMPANY

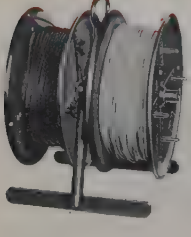
Eliminate pull-outs on Sealtite®...with famous KELLEMS GRIPS!

THE KELLEMS COMPANY, INC.

Say goodbye to Sealtite pull-outs on pendant controls, drip loops, moving heads, etc.—when you use Kellems Grips for Sealtite Conduit (Reg. T.M.: Anaconda). The Kellems Grip eliminates creepage and slippage of the fitting, prevents failure at the rigid fatigue point, controls arc of bend of the conduit and absorbs the stresses of flexing and vibration. Prevents movement and buckling of the neoprene jacket!

There are Kellems Grips for every Sealtite application. They're all described fully in our latest 24-page catalog. Get yours now. Simply circle number 33 on the Graybar postcard.

See how HYKON Reels can help you!



Hykon Reels make wire handling easier than you every thought possible. You can pull off wire absolutely straight and free, just as it was wound at the mill. No more kinks or tangles from pulling wire from a box! Reels are adjustable for all wire coils, both in width and coil eye. Outer disc is removable for easy loading of full coils of building wire, Romex, etc. Four and six unit Gang Reels are also available, as well as measuring units and extension cord reels. They're all described in our complete catalog and price list, which we'll be happy to send you. Just circle number 34 on the Graybar postcard.

HYKON MANUFACTURING COMPANY

For greater convenience and cost savings, Use TUFFLINE Portable Power Distribution Systems!

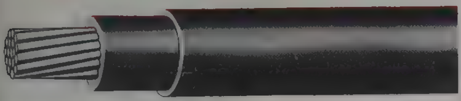
Here is a safe, completely U.L.-listed portable power distribution system to carry electric power from temporary service or portable generators for tools, lighting, and other electrical equipment at construction sites. It provides you a 3-pole system with Dynaprene® cord, neoprene molded connectors, all completely waterproof. Extensions are available and the complete package comes in a box that is perfect for storing.

Write today for complete information and specifications. Circle number 35 on the Graybar postcard.

TUFFLINE DIVISION WHITNEY BLAKE CO.

item...mail card to GraybaR!

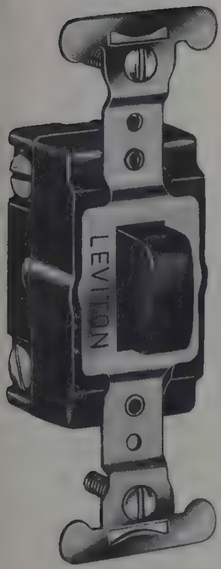
For quality construction and maximum service life, Insist on COLLYER Type RR Cable



Collyer Type RR Power and Lighting Cable is a tough, versatile cable designed for most environmental conditions. Install it in the air, in conduits or ducts, buried under ground, or aerially attached to a messenger. You can use it exposed to heat, cold, moisture, as well as oils and many chemicals. This is the same cable used for the State of Michigan's new $100,000,000 Mackinac Bridge, which uses thousands of feet of Collyer Products.

If you want to be sure that you are using the highest quality material on your jobs, acceptable for all types of municipal and private installations, do as more and more engineers everywhere are doing—"Call on Collyer". Call on us for our free catalog showing sizes, specifications, etc. Circle number 36 on the Graybar postcard.

COLLYER INSULATED WIRE CO.



LEVITON AC TOUCH SWITCH Installs in any position, gives positive, non-stalling action!

Here is a new Touch Switch that can be installed in any position and will provide positive, non-stalling action with a gentle touch from any angle. Only one inch deep, the new Leviton Switch is provided with heavy silver contact points to increase the safety margin and to prolong service life. Side-wired for convenience. High-capacity . . . will accommodate high inductive loads of fluorescent systems, or full rated capacity of incandescent filament lamp loads. Will take full load currents up to 80% of the switch rating for motor controls.

Recommended for new four-wire electrical systems requiring switches rated at 277 volts, in applications from homes and schools to hospitals and industrial plants.

This is only one of many Leviton Products designed to help you do a better job with greater customer satisfaction. They all are described in our new 16-page catalog, complete with price list. For your copy, circle number 37 on the Graybar postcard.

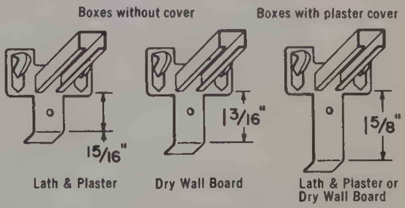
LEVITON MANUFACTURING COMPANY, INC.

NOW! STEEL CITY Adjustable Bar Hangers for all applications

Expanded line includes 3 depths for automatic positioning

FOOTED END PLATES
POSITION
BOX DEPTH

- Accurately
- Automatically
- Quickly



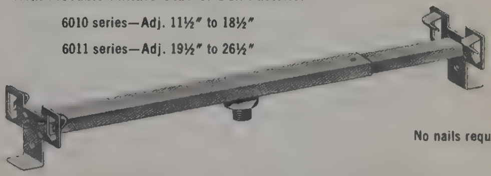
Foot depth is gauged for 1½"-deep outlet box—also adapts to 2⅛"-deep box and flush-mounted boxes.

ADJUSTABLE BAR HANGERS

With Movable Fixture Stud or Box Fastener

6010 series—Adj. 11½" to 18½"

6011 series—Adj. 19½" to 26½"

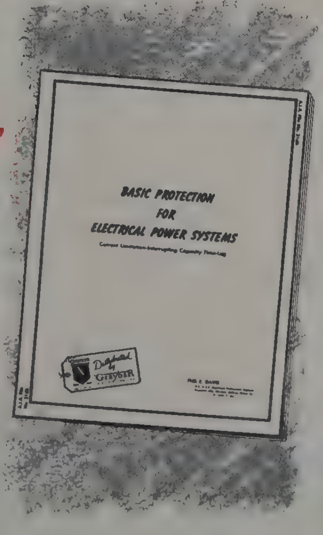


No nails required

For details circle number 39 on the Graybar postcard.

STEEL CITY ELECTRIC COMPANY

New handbook from makers of BUSS Fuses: "Basic Protection for Electrical Power Systems"



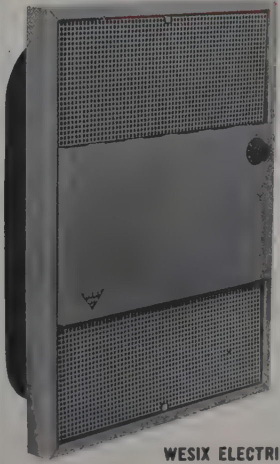
A new nandbook, just released and offered by the makers of Buss Fuses explains such terms as interrupting capacity, speed of response, and current limitation. Sections are devoted to motor protection, systems selectivity to faults, application and how to select fuses, etc. Valuable to even the most experienced contractor!

Charts included in the book show time of opening and current limiting effect of high-interrupting capacity fuses.

A free copy is available on request. Just circle number 38 on the Graybar postcard.

**BUSSMAN MANUFACTURING DIVISION
McGRAW-EDISON COMPANY**

Specify WESIX-IONIX Wall Heaters for modern design, high efficiency and easy installation!



This modern Wesix-Ionix Wall Convector features exclusive ion control to keep air clean, fresh, and free from pollen germs. Finished in decorative drift wood and ivory finish to complement home or office, it is only one of a complete line of modern automatic Wesix heating units, in capacities of 1500, 2000 and 3000 watts.

Write today for free literature which gives complete specifications on all units. Circle number 40 on the Graybar postcard.

WESIX ELECTRIC HEATER COMPANY

Major advance in electrical raceways... KRALOY Rigid PVC Conduit

A new concept in conduit! Kraloy provides longer service life and eliminates danger from rusting, pitting, and corrosion. Not affected by calcium chloride or other agents in concrete. Thus, Kraloy requires no protective coating. Moreover, it is immune to electrolytic action and harmful soil elements.

You will find, too, the ultra-smooth interior walls of rigid PVC Conduit make wire-pulling far easier. This not only saves time, but protects the conductors themselves. And since Kraloy is a non-conductor of electricity, and will not support combustion, you get an extremely safe material from any angle. Strong, yet flexible, Kraloy can be buried directly in the ground or encased in concrete without special handling.

A complete, well illustrated catalog describing Kraloy's properties completely, and providing charts for determining sizes and other specification information, is available right now. Circle number 41 on the Graybar postcard.

KRALOY PLASTIC PIPE CO.

Here's how KAISER ALUMINUM RIGID CONDUIT pays off for you in both seen and unseen values!

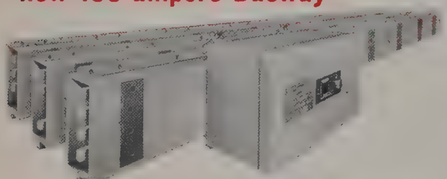
Kaiser Aluminum Rigid Conduit weighs only one-third as much as steel—this lighter weight pays off to you in seven key ways:

1. Important labor savings, since men work faster with lighter materials.
2. Permits use of smaller capacity for lifts, hoists, etc.
3. Permits lighter construction of job site storage facilities.
4. Provides greater handling safety, especially at high levels.
5. Less fatiguing to handle and install.
6. Reduced load permits many safe structural design economies.
7. Puts less load on storage and warehouse floors.

A handsome 32-page brochure has been prepared describing this new conduit, the savings it can provide, and installations where it has been used. For your free copy, circle number 42 on the Graybar postcard.

KAISER ALUMINUM AND CHEMICAL SALES, INC.

NATIONAL ELECTRIC announces new 100-ampere Busway

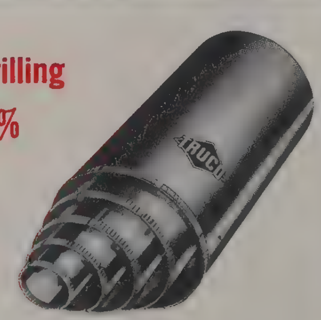


NATIONAL ELECTRIC DIVISION
H. K. PORTER COMPANY, INC.

Brand new! A compact, packaged Busway of 100-ampere capacity! "Speedbus" can be installed quickly and inexpensively, and is designed primarily to give you a completely flexible, yet true Busway system at an installed cost comparable to conventional conduit and wire. It can be used wherever electric lighting and power are needed in commercial, institutional and industrial type buildings. Three- and four-wire construction is standard.

Speedbus is made in pre-assembled sections of packaged five- and ten-foot lengths, ready to install with simple hand tools. An exclusive feature is the availability of 16 full contact, polarized plug-in outlets in every ten-foot length, spaced eight to each side of the Busway, back to back. Eight are incorporated into the five-foot length. For complete specifications on Speedbus, circle number 43 on the Graybar postcard.

Cut masonry drilling costs up to 70% with TRUCO Diamond Bits!



Truco Hi-speed Diamond Bits cut noise and offer savings ranging up to 70% when drilling clean, accurate holes in reinforced concrete, granite, marble, tile, asphalt, etc. Truco Bits come in sizes up to 20-inch O.D., in types to match your job and budget.

Truco portable diamond drilling machines —electric, gas or air-powered—cover the entire range of drilling. Accessories include Tru-Vac Vacuum Base. Get our new 8-page brochure showing all drilling accessories to make your jobs go faster with far less effort. Circle number 44 on the Graybar postcard.

TRUCO MASONRY DRILLING DIVISION
WHEEL TRUEING TOOL COMPANY

IF IT'S NEW AND YOU NEED IT... *WE HAVE IT!*

NEW . . . Graybar has the newest—all-weather plastic tape, positive safety receptacles, hand and power tools, wiring materials. Many of these new products you'll find in this booklet.

COMPLETE . . . one-word description of the lines at the Graybar counter, a **must** when YOU need something in a hurry—or to meet tough specs.

SERVICE . . . another word for Graybar, **the best of service**—at the counter, over the phone or through our Salesmen.

CALL GRAYBAR FIRST FOR EVERYTHING ELECTRICAL

Distributed by GraybaR ELECTRIC COMPANY

Broan

MIXED-FLO HOOD

with optional Charcoal Converter for Duct-Free Service

- Mixed-Flo principle features extremely low sound level performance . . . plus extra pressure for long duct runs similar to that of a centrifugal blower.
- Vertical or horizontal discharge to 3¼" x 10" duct.
- Fully unitized — no lost cabinet space.
- Fast running installation — comes prewired, preassembled . . . just remove outlet box cover to hook up power supply.
- Available in 4 sizes, in coppertone, antique coppertone, genuine stainless steel.

Charcoal Converter can be mounted on Mixed-Flo for duct-free installation.

DUCT-FREE HOOD COMBINATION

with Air Refreshing Charcoal Converter

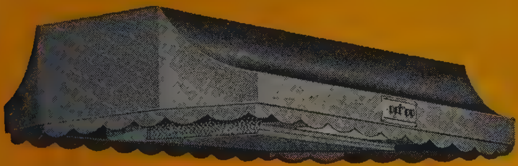
- Slim line converter mounts directly atop any Broan Dual Blower Hood or Mixed-Flo Hood for Duct-Free service.
- Converter removable should a ducted outlet be desired later.
- Converter comes equipped with oversized charcoal filter that adsorbs odors and smoke . . . refreshes air.
- Louvers are completely concealed, so that Duct-Free looks like a conventional hood.
- Available in 5 sizes, in coppertone, antique coppertone, genuine stainless steel; also decorator colors on special order.

Broan Range Hoods

– provide unmatched versatility

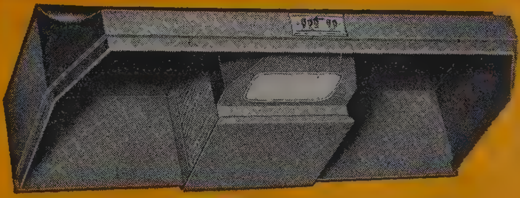
To meet your needs
To match your budget
To build your good name

No lost cabinet space



DUAL-BLOWER ISLAND HOOD

- A complete package — hood, blowers, light . . . factory prewired for fast, economical installation.
- Combines the engineering features and advantages of the regular Broan Dual Blower Hood.
- Available in coppertone, antique coppertone, genuine stainless steel; also decorator colors on special order.
- 36" and 42" sizes only.



DUAL-BLOWER HOOD

- Vertical or horizontal discharge to 3¼" x 10" duct without reducers or fittings.
- Heliarc welded construction.
- Spring-loaded backdraft damper prevents cold drafts and damper flutter.
- Combined blower and hood saves on cabinet space.
- Twin air intake with twin aluminum filters.
- Blower, light removable without tools.
- Available in 5 sizes, in coppertone, antique coppertone, genuine stainless steel; also decorator colors on special order.

Broan MANUFACTURING COMPANY, INC.
948 West State Street, Hartford, Wisconsin (near Milwaukee)

Specialists in Quality Ventilating Equipment for Over 25 Years

In Canada —
Manufactured by
Superior Electrics Ltd.,
Pembroke, Ontario

BRIEGEL
CAT NO 60
EASIER TO DO...
and costs less too!

B-M

INDENTER FITTINGS and TOOLS

Here is the combination that is unbeatable when it comes to easier E.M.T. installation at less cost. New lightweight plier size indenters make setting up thin wall conduit a breeze. B-M fittings are neater too! No unsightly nuts or projecting set screws.

A few more of the plus features of B-M fittings are Concrete tight—Vibration resistant—Extra heavy bright zinc plate, salt spray and acid drip tested for corrosion resistance—Extra heavy positive bonding locknuts—Smooth rounded edges or bushed throat type connectors that prevent insulation damage—All steel construction with extra heavy gauge wall thickness.

Red Throat
BM-21B
½″ Connector

Red Throat
BM-22B
¾″ Connector

Red Throat
BM-23B
1″ Connector

BM-41
½″ Coupling

BM-42
¾″ Coupling

BM-43
1″ Coupling

BM-51 BM-52
½″ Offset Connector
¾″ Offset Connector

BM-21
½″ Connector

BM-22
¾″ Connector

BM-23
1″ Connector

BM-No. 600
Changeable
Jaw Indenter

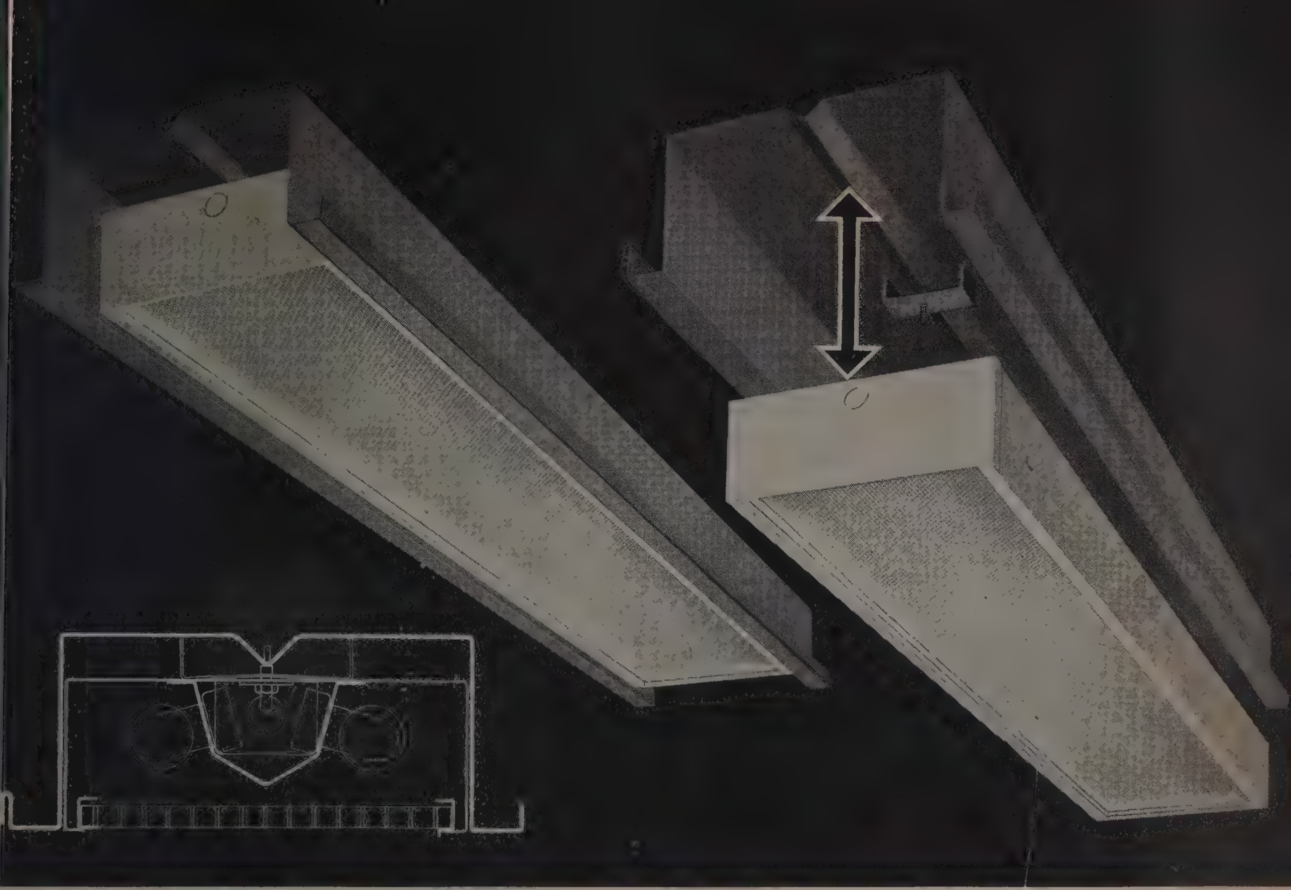
BM-No. 1000
Handvise for ½″,
¾″ and 1″ E.M.T.

BM-No. 100
Cutter for ½″,
¾″ and 1″ E.M.T.

BM-No. 607
½″ Indenter
BM-No. 608
¾″ Indenter

All B-M indenter type fittings far exceed the requirements of U. L. file card E 10863 and Federal Specifications W-F-406.

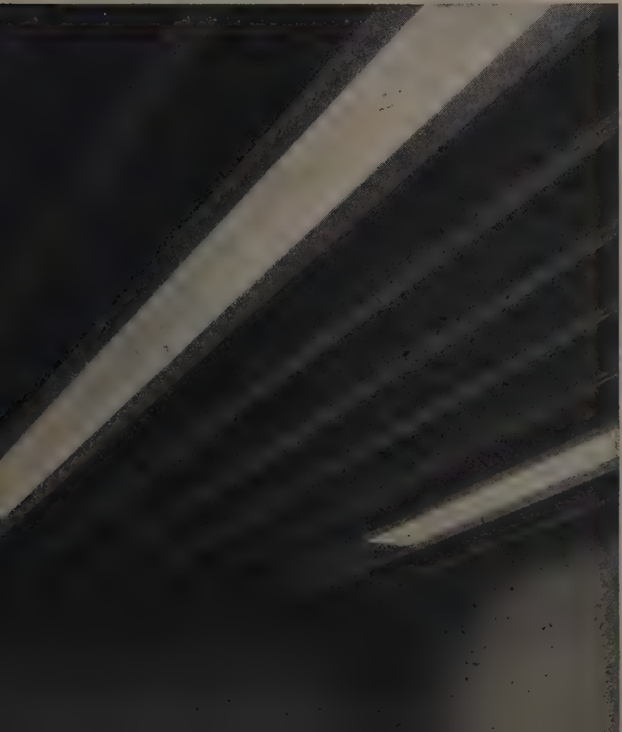
BRIEGEL METHOD TOOL CO.
GALVA • ILLINOIS



Here you see how easily new LPI troffers fit into flutes of Robertson Q-Deck. These rugged, die-formed steel fixtures are UL-listed with CBM-certified rapid-start ballasts, and are available in six stock diffuser types. Cross section shows simplicity of unit and convenience of installation. Troffers are wired complete, ready to go in.

New LPI troffers for Robertson roof deck

Note simplified treatment of the flush lighting. Adjacent cells can be closed off with acoustical ceiling material.



Versatile Robertson Q-Deck brings all the advantages of quick, clean, dry construction to modern buildings. LPI's new roof deck troffer is specially designed to combine with steel roof deck as a low-cost, functionally handsome ceiling and lighting system.

Architects, engineers, and contractors everywhere are discovering that the happy combination of Q-Deck and LPI troffers installed *within the cells* gives them an attractive low-cost lighting scheme for many new-construction situations.

Self-aligning hangers make for easy installation. Maintenance is simplified by easy-operating framed, hinged diffusers and by ready accessibility of all components. A wide choice of diffusers, including six stock models in formed acrylic, plastic louver, ventrolens, and glass, provides a selection of troffers for all applications.

For more information, write for Roof Deck Troffer Bulletin.

LPI FLUORESCENT LIGHTING

Lighting Products Inc., Highland Park, Illinois

more use these . . . .
IDEAL

than

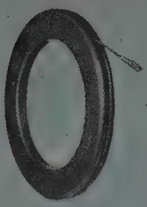
any other

WIRE-NUTS®

Did you know that every day more electricians make their wire splices with Ideal Wire-Nuts than with all other connectors combined? It's true! There are actually *billions* of Ideal Wire-Nuts giving safe, sure service today. Since its introduction in 1928 as the first successful screw-on connector, Wire-Nut has been the unquestioned leader. Through the years important design and material changes have been made to meet the advancing techniques and requirements of the electrical industry. Today, Wire-Nut has an unmatched record of proven performance, and is recognized by electricians and contractors everywhere as the lowest-cost and easiest method for all common branch circuit and fixture connections. Remember, there is no way known to make a stronger, more permanent wire joint!

For the tools and supplies you need on every wiring job, get the finest MADE BY IDEAL

NEW—FOR ALUMINUM CONDUIT

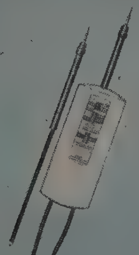


"FLEXI-STRAND", Ideal's new extra-flexible fish tape answers the problems of pulling wires through aluminum. It is made of high quality preformed galvanized aircraft cable. It is more durable, and stronger, and will far out-last ordinary flat tapes. So flexible it will easily take sharp bends in aluminum without cutting. Takes extreme flexing without kinking or taking a set.

"WIRE-LUBE" FOR EASIER WIRE PULLING

Easily applied by hand or brush to any rubber or plastic-covered wire or cable, as they are being pulled into conduit. Wire-Lube protects insulation against breaks, scrapes and strains. Slides wires around bends and thru tight spots. Dries to a fine lubricating powder that makes it easy to add or remove wires later. Noncorrosive, noncombustible, absolutely harmless to hands and clothes.

SUPER-SAFE VOLTAGE TESTER



Safest, easiest-to-use voltage tester made. Designed for rugged daily use. Case is seamless plastic in Safety Yellow, with no surface metal. Prods have extra-safe no-slip grips and 30" neoprene leads. Test for: VOLTAGE (110 to 550v AC; 110 to 600v DC) FREQUENCY (25 to 60 cycles), AC or DC. Solenoid calibrated voltage indicator functions separately from neon test lamp for super-safety. Available with special current-limiting resistors in each prod.

"E-Z" AUTOMATIC HAND STRIPPER

Strips standard branch circuit, fixture and lamp wire, and all other standard or solid wire. Automatic stop locks jaws open after stripping until wire is removed. Eliminates crushed wire ends. Available with eccentric adjustment on blades to limit cutting depth.

"T-5" LOW COST STRIPPER

A handy addition to every electrician's tool kit. Strips No. 10, 12, 14, 16 and 18 gauge wires quickly, cleanly, easily. Cuts and loops wire. Sturdy, compact, constructed of hardened steel for rugged duty and long service. Comfortable plastic grips for sure handling and safety. Overall size, 6". Flat design fits easily into pocket or tool kit.

THE HELPING HAND ON EVERY WIRING JOB

"SOLD THROUGH AMERICA'S LEADING DISTRIBUTORS"

In Canada:
Irving Smith, Ltd., Montreal

IDEAL INDUSTRIES, Inc., 1041-J Park Avenue, Sycamore, Illinois IDEAL

Yes! I want the new Ideal wire connector catalog. Also send me information on the full line of Ideal tools and supplies.

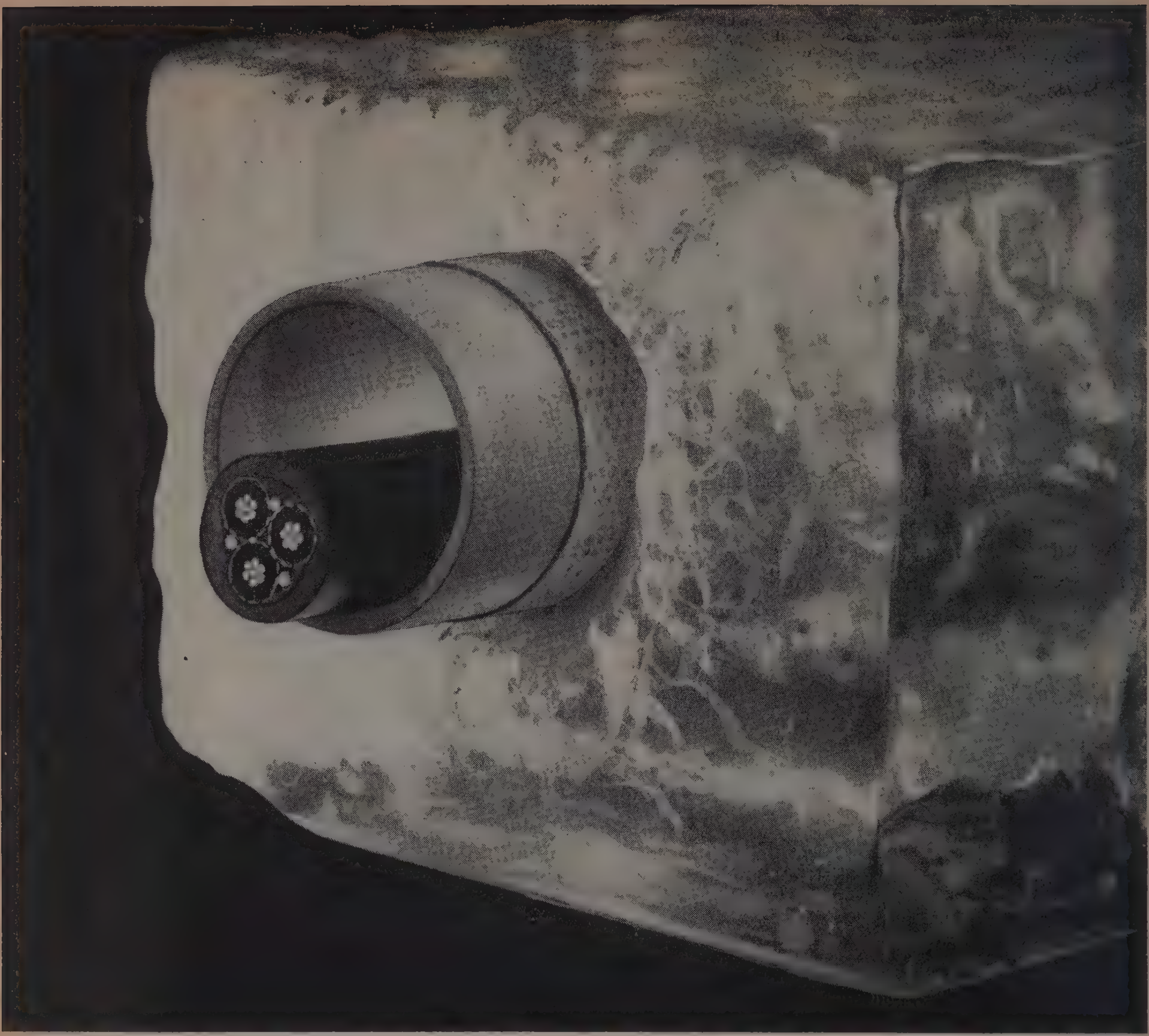
Name______________________________

Firm______________________________

Address____________________________

City________________Zone______State__________

© 1960, IDEAL INDUSTRIES, INC., Sycamore, Illinois

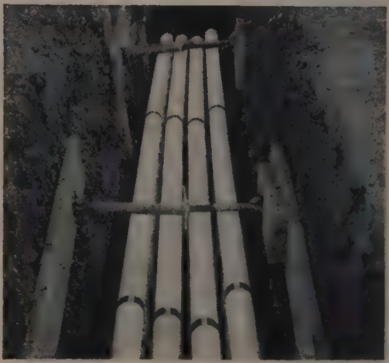


Cooler cables at lowest costs with Transite Ducts!

Do you know that electrical system losses amount to more than four hundred million dollars annually? Research shows that these losses can be drastically reduced by improving the dissipation of heat from conductors under load. The most efficient and economical way to accomplish this is with inorganic Transite® Ducts.

Tests prove that asbestos-cement Transite Ducts can actually have as much as 110.6% greater heat-carrying ability than organic ducts. This means that when a conductor is supplying a given load, its temperature will be substantially lower in Transite. These cooler cables result in lower electrical resistance with correspondingly lower I^2R losses. At a $20/KW cost, this can save you as much as $8.20 per thousand feet a year. Lower operating temperatures mean longer cable life and more reliable service, too!

Because of their 10′ lengths and speedy coupling method, Transite Ducts can be installed at the lowest cost. Get the full story by writing Johns-Manville, Box 14, ECM-10, New York 16, N. Y. In Canada: Port Credit, Ontario.



JOHNS-MANVILLE

JM

NEW

EXPLOSION-PROOF, DUST TIGHT, WEATHER-RESISTANT MOTOR STARTER and CIRCUIT BREAKER

PYLETS®

The Pyle-National Company announces their new series ECS threaded enclosure PYLETS, Model 60, for motor starters, circuit breakers and combinations. Designed for indoor and outdoor use in the most severe industrial environments. Class I, Groups C and D; Class II, Groups E, F, and G; and Class III (NEMA Types 3, 5, 7CD and 9EFG).

design features...

DOMES INTERLOCKED with BREAKER HANDLE
For Increased Safety

ACME SCREW THREAD CONSTRUCTION
For Ease of Maintenance

INSIDE THREADED TOP DOME
OUTSIDE THREADED BOTTOM DOME
For True Weather Protection

ALL ALUMINUM CASTINGS—STAINLESS STEEL EXTERIOR HARDWARE
For Realistic Corrosion Resistance

RUGGED OPERATING MECHANISMS
For Longer Life

ADJUSTABLE MOUNTING FRAMES
For Simplified Stocking

GLARE SHIELDED PILOT LIGHTS
For Easier Observation

THE PYLE-NATIONAL COMPANY
1344 North Kostner Avenue **Chicago 51, Illinois**

BRANCH OFFICES AND REPRESENTATIVES in the Principal Cities of the United States
MANUFACTURED IN CANADA by Pyle-National (Canada) Ltd., Toronto 15
RAILROAD EXPORT DEPARTMENT: International Railway Supply Co., 30 Church Street, New York 7
INTER AMERICA EXPORT DEPT.: Lionel-Essex Inter America, Inc., 15 East 26th Street, New York 10

CONDUIT FITTINGS ▪ CIRCUIT CONTROLS ▪ LIGHTING FIXTURES ▪ FLOODLIGHTS

ALCOA
ALUMINUM
RIGID
ISSUE

Hasn't sparked yet!

Another good reason why Alcoa aluminum electrical rigid conduit is gaining in popularity

You don't need special nonsparking tools with aluminum. It's nonsparking for safer installations.

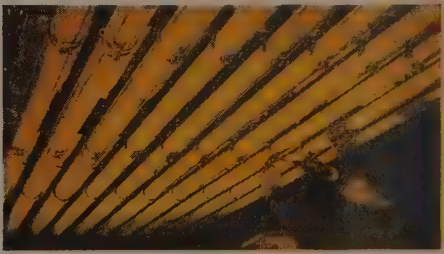
And, because Alcoa aluminum conduit *weighs less*, you can put it up faster. From warehouse to installation site you have only ⅓ as much weight to lift, load, carry and erect.

Cutting is fast—with hacksaw (or power tools on the larger sizes). Smaller sizes can be bent quickly, easily with an EMT bender. Use regular conduit dies (sharp ones, please!) and regular cutting oils for threading.

Wirepulling is easy too, since Alcoa aluminum conduit has a smooth, specially lubricated interior.

Competitively priced, aluminum conduit, also *offers corrosion-resistance, long life, good appearance*. Why not get all the facts and figures from your electrical distributor or one of our representatives.

Free literature on request. Just drop a line to Rome Cable Division of Alcoa, Dept. 7-100, Rome, New York.



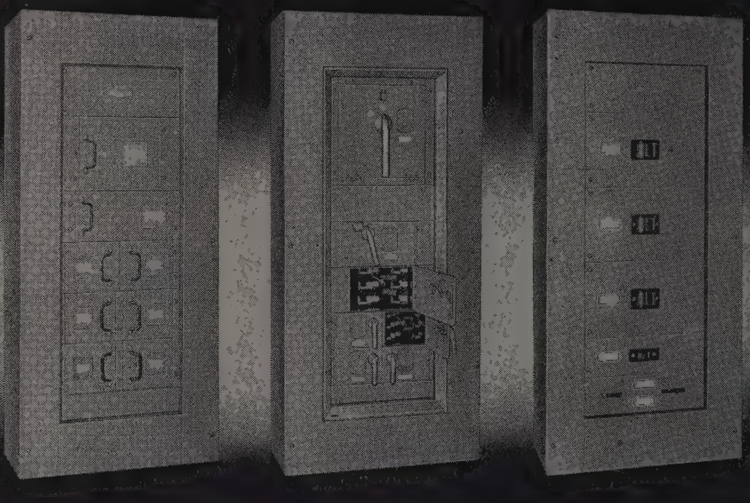
Goes up faster Lightweight Alcoa conduit makes handling easier and faster—from warehouse to installation.

ROME CABLE
DIVISION OF **ALCOA**

Now there's one just right for any installation . . .

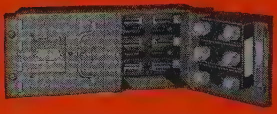
FRANK ADAM

Feeder Panelboards



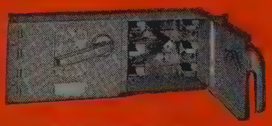
Your preference—with or without doors!

BRANCHES



KSF HINGED TYPE . . .

Fusible switch, 30 to 600 amps.—250-v. AC or DC; 2 and 3 poles, single and double throw.



[illegible] TYPE

Quick-make, quick-break fusible switch, 30 to 600 amps.—250-v. AC or DC; 600-v. AC, 2 and 3 poles.

CIRCUIT BREAKER TYPE . . .

Automatic protection, 15 to 800 amps.—250-v. AC or DC; 600-v. AC, 2 and 3 poles.

See our catalog in SWEETS

From Frank Adam's complete line of feeder panelboards you can pick the one that fits your installation requirements perfectly—*with or without a door.*

★ **BIG GUTTERS** simplify wiring, reduce installation time!

★ **"ADD-ON" FEATURE** enables additional branches to be added as needed by merely installing oversize enclosures with blank space covers!

Outstanding and unique "plus" features like these add up to a competitively priced product that gives you more in dependability . . . more in quality . . . more in safety. Get the facts—*write for catalog!*

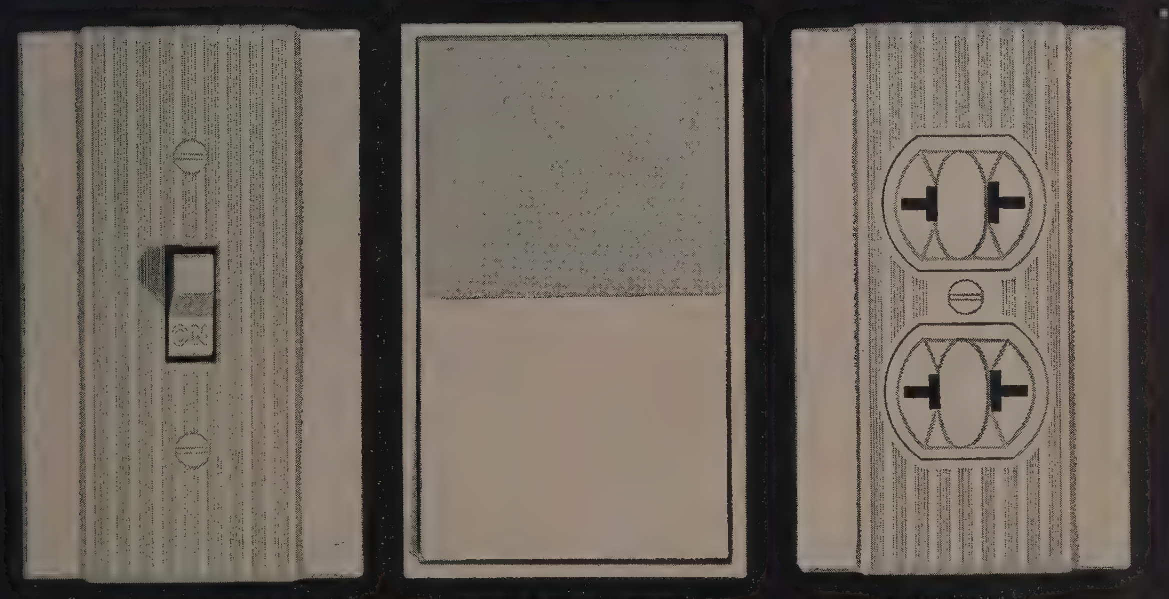
All FA feeder panelboards are UL approved.

FRANK ADAM ELECTRIC COMPANY
P. O. BOX 357, MAIN P. O. · ST. LOUIS 66, MO.

Busduct • panelboards • switchboards • service equipment • safety switches • load centers • Quikheter

At last--wall switches and plates that are really

WHITE



CONVENTIONAL WALL SWITCH AND PLATE

FASHION PLATE WALL SWITCH

OUTLET AND PLATE

For some time, there has been a critical designer-decorator need for *pure* white plastic wall switches, outlets, and plates. *And ivory has passed for white long enough!*

Now, Bryant announces a line of *true* white plastic wiring devices including: conventional wall switches, outlets, and a variety of wall plates . . . and, of course, the stunning all-white Fashion Plate® wall switch.

J-9905-1

For additional information, contact your Bryant representative, or write The Bryant Electric Company, Bridgeport 2, Conn.

The exciting things come from

BRYANT

THE BRYANT ELECTRIC COMPANY
BRIDGEPORT 2, CONNECTICUT

How would your customers

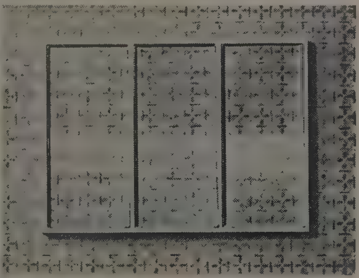
like a wall switch like this?

Build profits and prestige with the new, improved Fashion Plate switch

. . . the no-button, no-toggle, quiet, good-looking luxury wall switch that obsoletes every other switch on the market!

. . . the only switch with the plate-sized actuator that can be backed with any color or pattern. A decorator's dream!

Whether you specify, sell or install Fashion Plate, this popular luxury wall switch adds to your reputation and potential for increased business . . . through the pride and satisfaction of every customer who buys it. It upgrades his home or building . . . and his estimate of your operation.

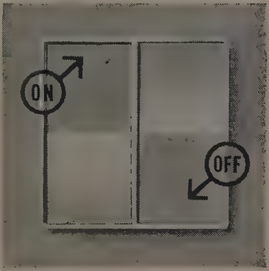


Here's how it looks

Pattern possibilities are unlimited! Contrasting combinations of black or white frames, ivory or white actuators — or clear actuators that can be backed with paint, fabric, or wallpaper. One to four gang choice.

and how it works

A light touch at the top of the plate . . . lights "ON". A light touch on the lower half . . . lights "OFF". No button or toggle to fumble for. Package-laden shoppers can operate it with an elbow. Quiet operation . . . no loud snap.

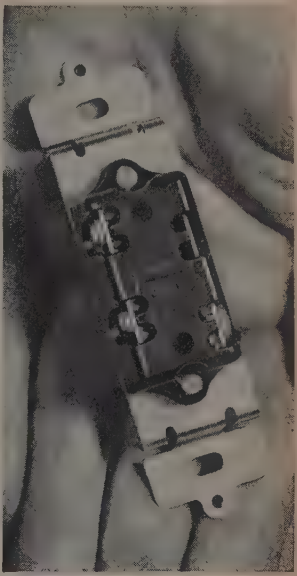


Easy to install

Interchangeable with any standard wall switch. Simply mount switch and plate in box. Press in actuator. That's all! Quality built, safe and durable.

Improved design and action

New type of *circular grip* holds actuator securely, but permits easy removal for decorating. Unique over-center mechanism, super-positive action, no "hang-up," no momentary contact, non-oxidizing silver-alloy contacts.



Versatile, compact design

Fits all standard switch boxes. Rated 15 and 20 ampere AC only, 120-277 volts. Single-pole, double-pole. 3-way, 4-way. 1, 2, 3, or 4 gang.

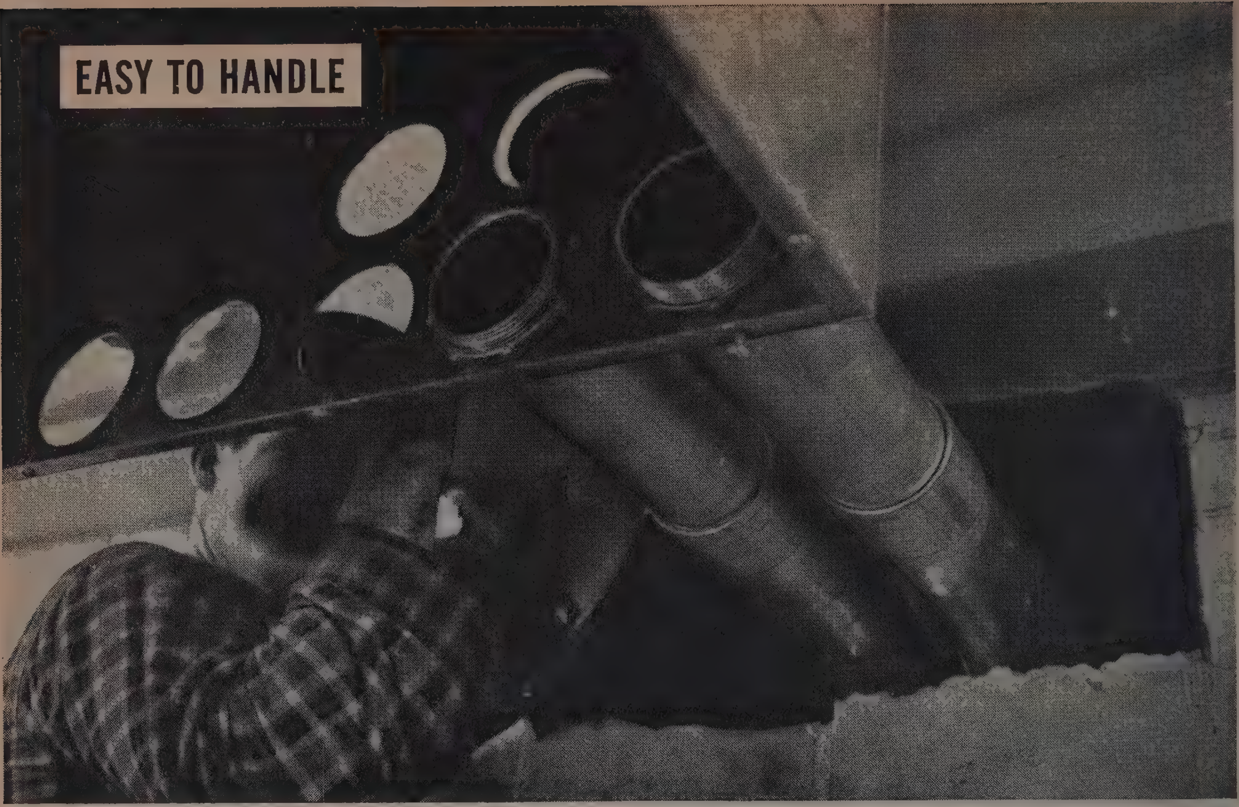
Clamp-type, back wiring terminals

A real time saver! Feed-through design is faster and easier than wrap-around terminals — and stronger too.

Fashion Plate . . . the only switch with plate-sized actuator that combines form and function so well. Get the full story on the new, improved Fashion Plate.

BRYANT

THE BRYANT ELECTRIC COMPANY
Bridgeport 2, Connecticut

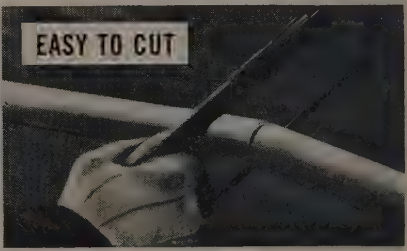


Reynolds Aluminum Rigid Conduit LOWERS INSTALLATION COSTS

Here's why: Reynolds Aluminum conduit bends and forms easily and accurately. And, because aluminum is so lightweight—weighing one-third as much as steel, it can be handled and installed easily. Important to everyone concerned with maintenance is the fact that aluminum can't rust ever—and also resists corrosion due to weather and most industrial atmospheres. Even threads cut on the job can't rust.

Reynolds Aluminum Rigid Conduit is non-magnetic, reduces voltage drop, makes longer runs or smaller conductors possible.

For complete information and names of Reynolds Aluminum Rigid Conduit distributors, call your Reynolds Sales Office or write *Reynolds Metals Company, Box 2346-ET, Richmond 18, Va.*



Watch Reynolds new TV show "Harrigan & Son", Fridays, starting October 7; also, "All Star Golf", Saturdays, resuming October 15—ABC-TV. And on Sunday, October 16, be sure to see the exclusive showing of America's new 1961 cars on The National Automobile Show, direct from Detroit over CBS-TV, 6 to 7 P.M. EDST.

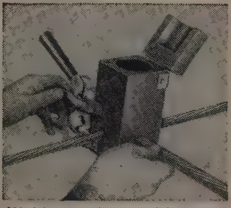
on your
next bill
of materials–

see your

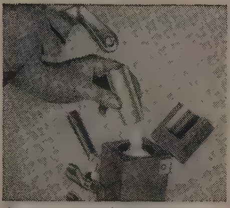
BURNDY
DISTRIBUTOR
for all
of these
connections
made
with

thermOweld®

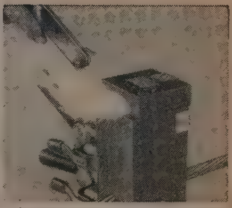
welds a permanent
electrical connection
asily and economically
any copper conductor
or steel structure



Weld anywhere with lightweight THERMOWELD. Self-contained, needs no external source of power.



Pour powder into mold, tap. Starting powder won't mix with welding powder, assures positive firing.



Close cover, ignite with flint gun. THERMOWELD forms liquid copper which fuses conductors into solid mass.

BURNDY

60-7

NORWALK, CONNECT. • BICC-BURNDY Ltd., Prescot, Lancs., England • In Continental Europe: Antwerp, Belgium • TORONTO, CANADA

Your cheapest insurance against sudden darkness

When the lights go out, Exide Lightguard® goes on automatically. It protects you from panic, damage and pilferage when power sources are interrupted. Plugs into a regular outlet—charges itself automatically—provides light when you need it the most.

Exide Lightguard comes in three different models designed to your needs. Be protected—write for full details. Exide Industrial Division, The Electric Storage Battery Company, Philadelphia 20, Pa.

Exide®

NTRODUCING . . .

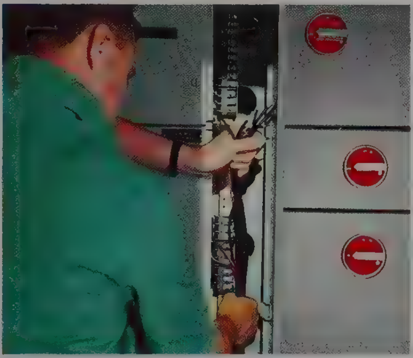
ADVANCE
CONTRO

14 new features for
TOP PROTECTION OF PEOPLE, EQUIPMENT
including . . .

POLYESTER "SANDWICH" isolates, insulates vertical bus — blocks spread of fault from starter to vertical or horizontal bus; guards personnel from accidental bus contact.

WEDGE-LIKE UNIT STABS — under c
pressure—engage vertical bus, pro
contact; expand under short cir
prevent "pop out" during fault.

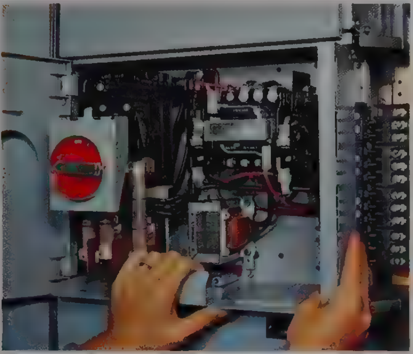
12 new features for
FAST AND EASY FIELD INSTALLATION
including . . .



ISOLATED WIRE TROUGH provides roomy area to "lay in" wire and make control and load connections. Separate full-height door makes wiring installation and inspection easy.

CONVENIENT TYPE B TERMINAL BLOC
in wiring trough—is accessible wi
out. Sliding coded cover insulator
cidental contact with terminals.

10 new features for
SIMPLE INSPECTION AND MAINTENANCE
including . . .

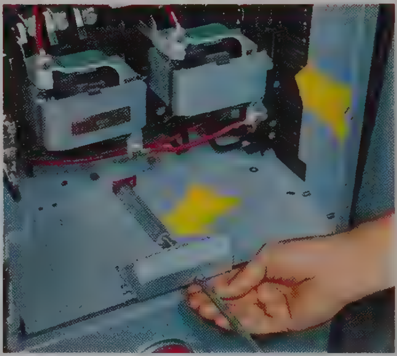


DRAWOUT CONNECTIONS permit starter unit removal or insertion without disturbing load or control wiring; allow inspection of individual starters without complete shutdown.

UNIQUE SLIDING COVERS close to f
isolation barrier . . . open easily to
inspection and maintenance of the
horizontal bus connections.

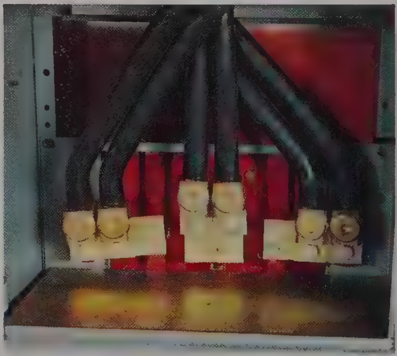
D-DESIGN
L CENTER

ble-spring
de positive
t stress to



POSITIVE UNIT GUIDANCE SYSTEM — slot on starter unit and matching track on barrier—gives smooth travel of unit, positive alignment of stabs and drawout "B" block.

-fixed half
unit in or
revent ac-



INCOMING LINE TERMINAL compartment can be located at top or bottom, allows straight-line cable terminations — eliminates bending and looping of heavy cables.

n effective
rmit front
ertical and

ROTARY HANDLE MECHANISM — for circuit breaker or fused switch — is mounted on unit; gives positive interlock; clearly shows device position; locks "ON" or "OFF."

CONTROL CENTER

. . . all-new grouped control for independent or coordinated units

Now . . . from General Electric comes the all-new, *advanced-design* Control Center. Combined in this center are more than 40 new features that add up to outstanding performance in equipment protection, personnel safety, and ease of installation and maintenance.

This centralized control for a-c and d-c motors also provides interlocking and sequencing of motor operation and over-current protection of feeder and branch circuits—including lighting. The *advanced-design* Control Center—with short circuit interrupting capacity up to 100,000 amperes — will handle: (1) motor starters to NEMA Size 6; (2) feeder circuits to 800 amperes; and, (3) power concentrations to 1200 amperes.

The building-block, modular construction of the General Electric Control Center adapts quickly to a variety of layouts to fit available space . . . permits optimum arrangement of starter units within each section to meet any application. This flexibility of design makes allowance for future expansion or modification to meet changing requirements . . . without costly downtime or major added investment.

For complete information on *advanced-design* General Electric Control Center, contact your General Electric Sales Representative or Distributor. Or, write General Electric Co., Schenectady 5, N. Y. *Industry Control Dept., Salem, Va.; Distribution Assemblies Dept., Plainville, Conn.* 783-17

GENERAL ELECTRIC

RE
T
STEM

luorescents
-overnight
scents with
light as his
.

es that cut
nd like the
art circuits.
more light
today—or
12, Ohio.

RIC

Get starter modifications . . . fast . . . from your General Electric distributor

When a last minute change in application requirements necessitates immediate modification of a magnetic starter, call your General Electric apparatus distributor. He can provide the proper modification kit right off the shelf. Even when your starter is installed, it can be modified on the job in minutes.

Your General Electric distributor stocks industry's most complete line of modification kits. This means he can supply nearly any starter you need—when you need it.

Modifications are easy to make. All necessary parts are included in each kit, and a screwdriver is the only tool needed.

Kits for magnetic starters are available for mounting push buttons, selector switches, or indicating lights in starter enclosures; for adding auxiliary contacts and third overload relays; for changing coils and fuse clips.

For more information, contact your General Electric apparatus distributor or sales office. Or request publication GEA-7020 from General Electric Company, Section 812-03, Schenectady 5, N. Y.

You get **MEASURABLE ADVANTAGES**
with General Electric Control

Progress Is Our Most Important Product

GENERAL ELECTRIC

“You don’t have to be young to be up to date”

“I was past 50 when I learned about circuit breakers. Now I wouldn’t use anything else.

“Sure, I’ll admit the younger fellows are the ones who use circuit breakers the most today. They say it’s because they’re more up to date. Don’t believe it. They just didn’t have any old-fashioned habits to break, like some of us old hands did. And I can show you some youngsters who aren’t up to date yet.

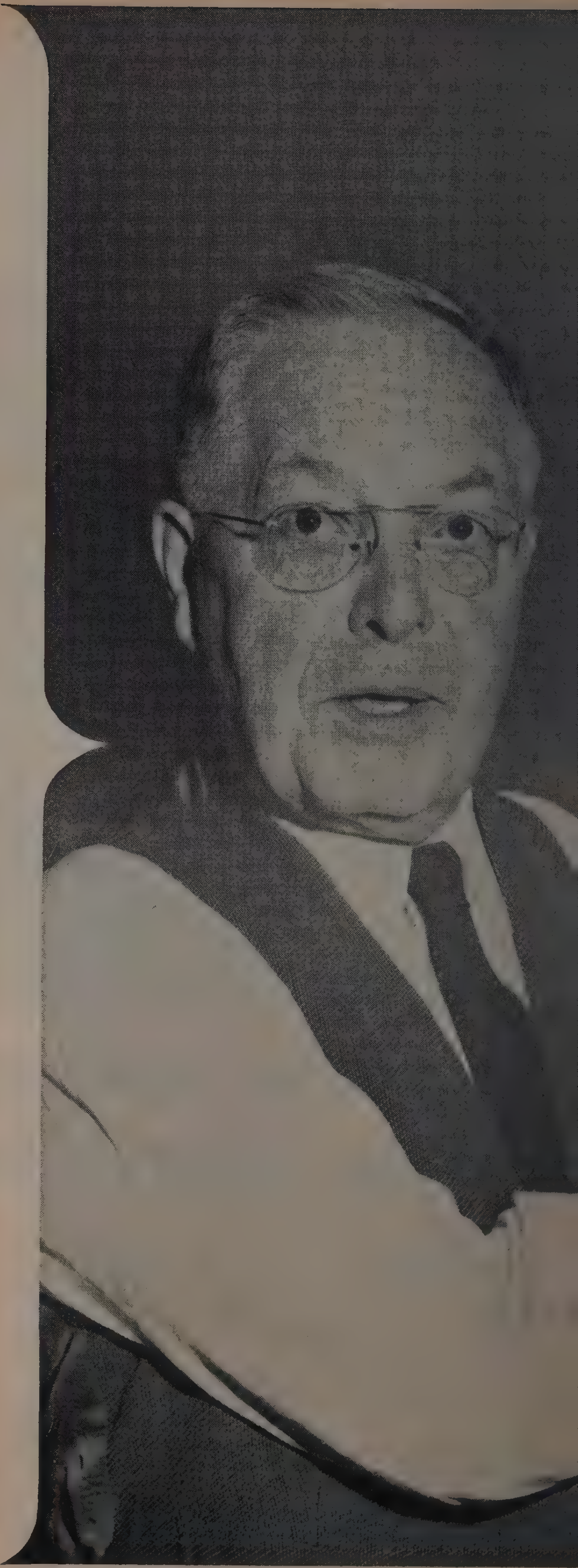
“The crazy reasons they think up for not using circuit breakers. Say they cost too much. The fact is nothing costs less than a circuit breaker. First, there’s nothing to replace. Second, you get power back faster. And third, you don’t have people and machines standing around doing nothing.

“Actually a circuit breaker usually pays for itself over and over again in any industrial plant . . . protecting motors, machines, lighting circuits, and bench outlets.

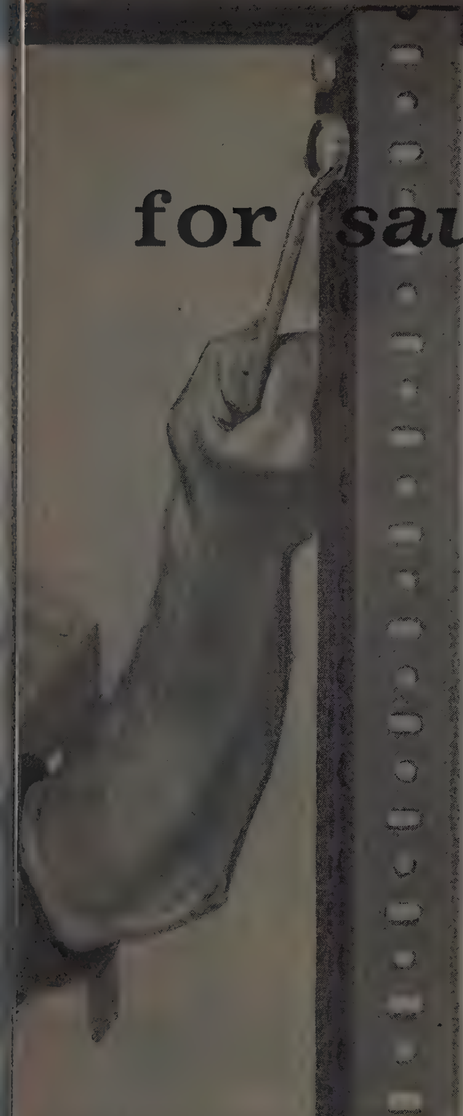
“What brand should you buy? Look at I-T-E. Then see if you could possibly be satisfied with anything else.”

Send for the new free bulletin on how circuit breakers benefit industrial plants. Or see your distributor. I-T-E Circuit Breaker Company, Dept. SA, 1900 Hamilton St., Philadelphia 30, Pa.

I-T-E | **I-T-E CIRCUIT BREAKER COMPANY**



framework



for *saving* in 1,000 ways

AIM BRAND SLOTTED ANGLE

CUTS COSTS AS IT QUICKENS EACH JOB

AIM Brand Slotted Angle offers eye-opening economies for virtually all of your framing, mounting and hanging jobs. It can actually free your skilled men from normally tedious tasks without sacrificing *professional* results. Here's exactly how:

1. Simple assembly. An inexperienced, unskilled man can master it in minutes. He only needs a hand wrench—no drilling, sawing or welding

2. Fast assembly. Once lengths are figured, they're quickly snipped to size with the AIM Brand Cutter. No guessing—cutting marks are spaced every 3 inches. Next, simply bolt together. ⅜" holes accept all standar electrical fittings—no reaming, no special adapters.

3. Keeps step with spec changes. Example: Need more runs of conduit? Add on to the AIM Brand Slotted Angle and you're all set.

4. Cuts costs all along the line. All savings totaled—initial material cos handling, sizing, cutting and assembly time—job costs can be cut as muc as 40% on every installation: Investigate today. AIM Brand Slotted Angl is distributed nationally. For the name of your nearest distributor and free, illustrated booklet, call or write your nearest ACME STEEL office or ACME STEEL COMPANY, Fabricated Materials Division, Dept. EAD-10 135th Street & Perry Avenue, Chicago 27, Illinois.

Mounting switch gear.

Supporting runs of conduit.

Free standing mount for apparatus.

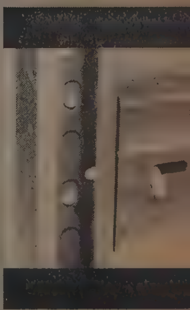
NEW STORAGE SAFEGUARD

AIM Brand Racks for heavy duty storage offer greater stability, installation ease and load capacities.

Exclusive safety load locking device* and two button head studs provide three point bearing per beam connection for positive protection against accidental disengagement of beams.

Write for details.

*Patent applied for.



ACME STEEL IDEA LEADER IN FRAMING

AIM BRAND

New Sola 2-lamp parallel mercury lamp transformer... keeps other lamp burning should one lamp fail

Sola's new weatherproof 400-watt 2-lamp parallel transformer puts an end to double outages. Because its circuit provides complete electrical independence between the two lamps, with negligible interaction, the failure of one lamp does not significantly affect the operation or light output of the remaining lamp. Sola's proven constant wattage principle insures a regulated, safe power flow to the remaining lamp — guards against damage from current surge.

The smallest, lightest-weight transformer of its kind on the market, this new unit can help you cut outdoor lighting maintenance costs to the bone. Cased in anodized aluminum, it weighs only 47 pounds — far less than equivalent units with steel cases—making it ideal for pole-top mounting with less wind loading and greater installation convenience. And because it has only one core-and-coil, it is far lighter and smaller than competing two-core parallel transformers.

The case features a new kind of weatherproof seal to insure a positive fit with normal case expansion and contraction. Under ambient temperature changes severe enough to crack a solder seal, this flexible plastic gland "gives" to keep the seal tight and protect against moisture penetration to the internal components.

For parallel operation of two 400-watt H-1, H-25, H-33 lamps

Primary Voltage	Cat. No.	Min. Start. Temp. °F.	Wt. Lbs.	Diam. in.	Ht. in.
100-130/200-260	77-10-246	−20	47	6⅝	12
180-235	77-15-246	−20	47	6⅝	12
240-315	77-12-246	−20	47	6⅝	12
200-260 x 400-520	77-11-246	−20	47	6⅝	12

Your nearest Sola representative will be happy to give you more information about Sola Constant Wattage Mercury Lamp Transformers.

Write for Bulletin MV

SOLA

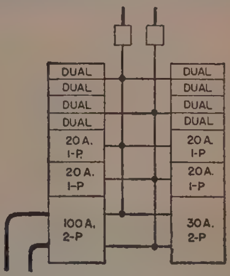
BPC A Division of Basic Products Corporation

SOLA ELECTRIC CO.
Busse Road at Lunt Elk Grove, Illinois
HEmpstead 9-2800 (Chicago Phone: NAtional 5-8630)

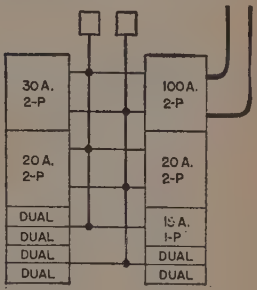
I-T-E
Uni-Pak
PANELS

FLEXIBILITY

AS A BRANCH OR SUBFEED



AS A MAIN DISCONNECT



AND NOW: 100 amp 2-POLE THAT TAKES ONLY 2 SPACES

Now . . . the EQ-P 2-pole 100 amp circuit breaker is available to make the Uni-Pak loadcenter even more flexible than ever. It is the *first* and only plug-in 100A 2-pole that takes up *only two pole spaces!*

I-T-E plug-in circuit breakers plus the I-T-E Uni-Pak give you the best and most flexible loadcenter line available today. Dual rated Uni-Pak loadcenters plus the 100A 2-pole allow you to convert the economical main-lugs-only loadcenter to a single main disconnect. In addition, the space saving EQ-P 100A 2-pole allows you more branch circuit space.

For additional information, write I-T-E Circuit Breaker Company, Walker Division, 125 Bennett Street, N. W., Atlanta 9, Ga. Ask for Bulletin NI-100.

I-T-E

I-T-E CIRCUIT BREAKER COMPANY
WALKER DIVISION

To help you promote your biggest year in electric heating

Electromode's Complete For The

YOUR PROFIT PARTNERSHIP PROGRAM
MODEL HOME PROMOTION
Electromode
PROFIT PLANS KIT
Your guide to bigger electric heat sales. All of the materials sales
Electromode
PROFIT PARTNERSHIP PROGRAM

Profit Partnership Program offers a new avenue of approach in selling electric heat to the builder. It's a complete step-by-step sales and sales promotion program, including specific advertising and promotional materials, sales literature, direct mail, consumer ad reprints, publicity ideas, and point-of-sale displays.

Local Merchandising Aids are all prepared—a newspaper mat service . . . radio and television spot commercials — all stressing benefits of electric heating. Outdoor advertising, direct mail, publicity, store identification, displays—and a new Yellow Pages program—are available.

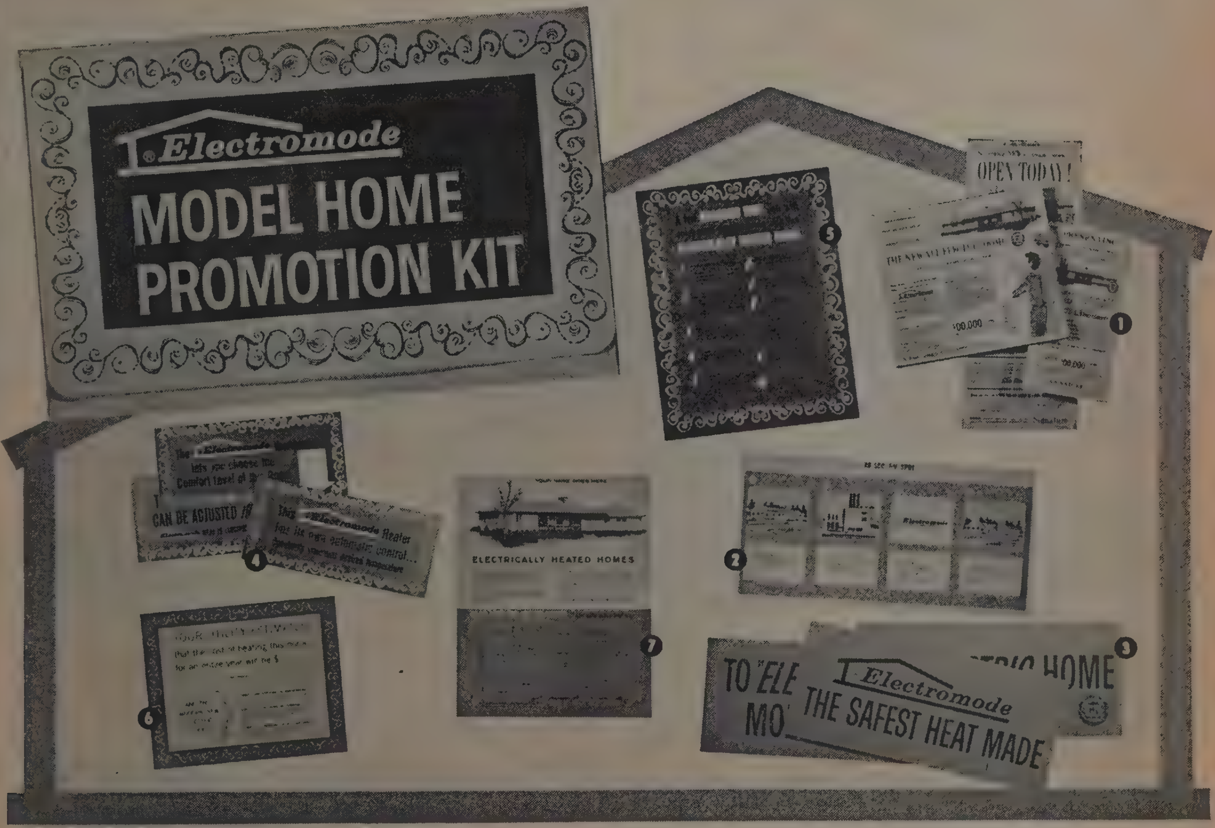
Model Home Promotion gives you a packet of advertising materials to sell electric heat in the builder's model home. It helps you sell electric heat by helping the home builder sell his home. This special folder helps sell the builder promotional and marketing ideas and materials.

Profit Plans Kit details step-by-step sales programs for model homes, custom homes and home modernization. It includes "use the user" ideas, publicity ideas, materials and methods for utilizing promotions and advertising. Gives full details on ordering Electromode promotion materials.

FOR YOUR COPIES OF THE ELECTROMODE PROFIT PARTNERSHIP PROGRAM

see your Electromode representative or send $1.00 to cover cost of handling and mailing to: Electromode Division of Commercial Controls Corp., P. O. Box 1052, Rochester 3, N. Y.

New Sales Aids Program Electric Heating Field



MODEL HOME PROMOTION KIT includes seven big aids.

Model Home Promotion Kit helps you sell the builder . . . helps the builder sell his homes. It gets electric heating in on the ground floor with promotion-minded builders. Here are some of the items it includes.

❶ **Suggested Newspaper Ads** . . . three layouts to focus attention on all-electric model homes in your area.

❷ **TV Spots** . . . 20-second spots to be used by the builder, promoting electric heat.

❸ **Outdoor Signs** . . . stop traffic outside, direct people into and through the home.

❹ **Wall Signs** . . . for use near electric heating units to pull prospects to the product.

❺ **Wall Chart** . . . lists 10 reasons why electric heating is an economical buy.

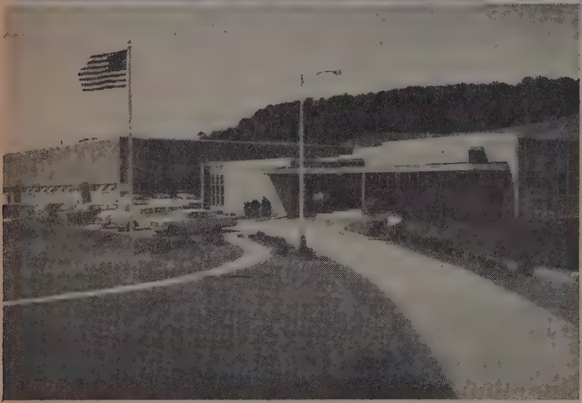
❻ **Utility Heating Cost Estimator** . . . gives prospects an estimate of year-round utility costs.

❼ **Floor Plan Sheet** . . . individually tailored to show floor plan of the home . . . promotes electric heat. Prospect may take this home.

® **Electromode**

570 CULVER ROAD
ROCHESTER 3, N. Y.

DIVISION OF COMMERCIAL CONTROLS CORPORATION



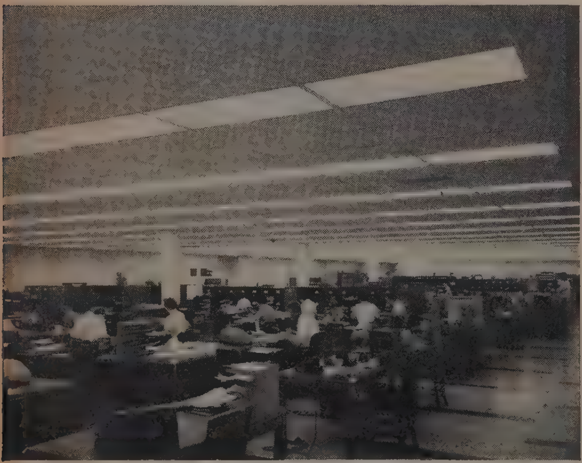
With Sylvania's Very High Output Fixtures..... PRECISION

The moment you enter this brand new Robertshaw-Fulton plant at New Stanton, Pa., you realize the detailed planning that went into its design and construction.

This one immense production area (740′ long x 300′ wide) now handles the facilities of the Robertshaw Thermostat Division formerly housed in three separate plants. Modern conveniences and surroundings aid plant and office employees to turn out precision products at top efficiency under ideal working conditions.

One of the major factors in creating this excellent working atmosphere is the lighting throughout the building. In the production areas over 1500 Sylvania very high

Robertshaw Thermostat Division of
Robertshaw-Fulton Controls Co., New Stanton, Pa.
Engineers and Constructors—
The Rust Engineering Co., Pittsburgh, Pa.
Electrical Contractor—
Allegheny Industrial Electrical Co., Inc., Pittsburgh, Pa.



Sylvania's 2′-wide Troffers provide attractive, glare-free lighting in the general and private offices. Sylvania's pendant and surface-mounted fixtures illuminate other building areas.

222,000 square feet of production space in the Robertshaw-Fulton plant at New Stanton, Pa., receive over 120 fc. of lighting from more than 1500 Sylvania Very High Output fixtures. Mounting height-17 ft., spacing-20 ft.

LIGHTING AIDS PRECISION PRODUCTION

at new plant of Robertshaw-Fulton

output fixtures with 1500 ma lamps provide 120 footcandles of even comfortable illumination.

The general office, cafeteria and private offices utilize Sylvania's 2′-wide Troffers with diffuse glassware shielding for pleasant, glare-free lighting.

Still other parts of the building use different Sylvania lighting equipment. The lobby and reception area features Sylva-Lume, one of Sylvania's modular lighting systems. In the Research Department Sylvania's Tartan fixtures provide the right answer. And in certain low-ceilinged areas the choice was Sylvania's shallow surface-mounted Mohawk fixtures.

The modern combination of plant and office facilities at Robertshaw-Fulton illustrates the ability of Sylvania's broad fixture line to provide the *right* kind of lighting equipment for *any* situation.

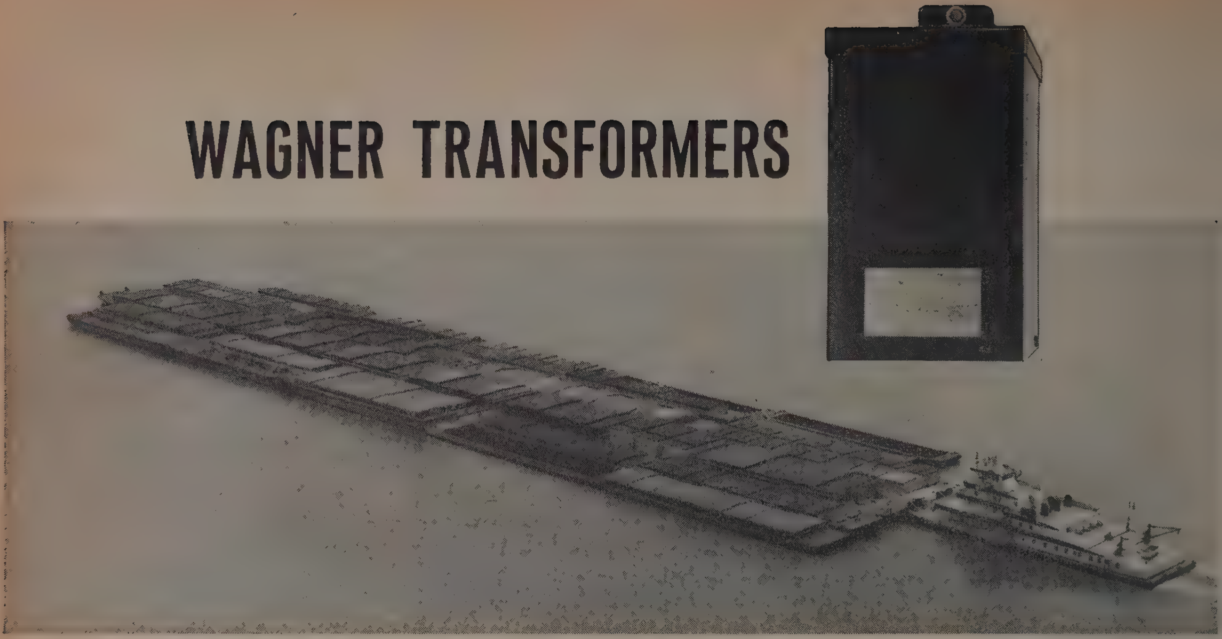
When you have a lighting problem, whether large or small, don't limit your choice. Call on Sylvania and select the lighting equipment that suits your exact needs. A Sylvania lighting specialist will be glad to help you with your lighting problems.

SYLVANIA LIGHTING PRODUCTS
A Division of SYLVANIA ELECTRIC PRODUCTS, INC.
One 48th Street, Wheeling, W. Va.

SYLVANIA

Subsidiary of ***GENERAL TELEPHONE & ELECTRONICS***

WAGNER TRANSFORMERS



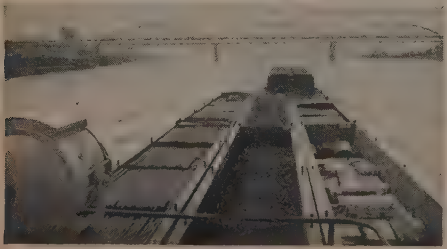
RIDE OL' MAN RIVER

Out in the channel, that's Federal Barge Lines' M.V. UNITED STATES. Designed and built by St. Louis Shipbuilding & Steel Co., she's the most powerful towboat on America's inland waterways. Headed up the Mississippi, this 8,500 horsepower giant pushes a record-breaking 42 barges, the equivalent of seven and one half acres. The boat is designed to push 40,000 tons of cargo, the capacity of a freight train 1,000 cars long.

You'll find seven Wagner Dry-Type General Purpose Transformers on duty aboard the UNITED STATES. Six 10 Kva and one 7½ Kva transformers (all 480 volt primary, 120/240 volt secondary, with 2 extra primary taps) are used to power this muscled lady's lighting system, small motors, and most of her navigation equipment.

Ashore or afloat, Wagner Type AE Transformers can be used for all general purpose applications, including those where noise must be minimized. They have a low sound level, the result of encasing smaller Form W core and coils in solid epoxy compound... give you a whisper-quiet transformer that can be used anywhere noise would be a nuisance.

Wagner Type AE Transformers have insulation protection suitable for continuous operation at 80°C in a 40°C ambient. All parts are sealed from dust, moisture, and corrosion by the epoxy compound. Naturally, every unit is built to conform to all applicable standards of ASA and NEMA.



Wagner Type AE Transformers can be installed indoors or out... anywhere they will not be submerged or exposed to injurious fumes in concentration. Compact and lightweight, they can be mounted in any position at any angle, on walls, floors, or ceilings.

Like to know more? Wagner branches and distributors have all the details. There's one near you, listed in your 'phone book. Call or write. Soon.

WT60-13

Wagner Electric Corporation

6413 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI

he men who really know... know Efcor

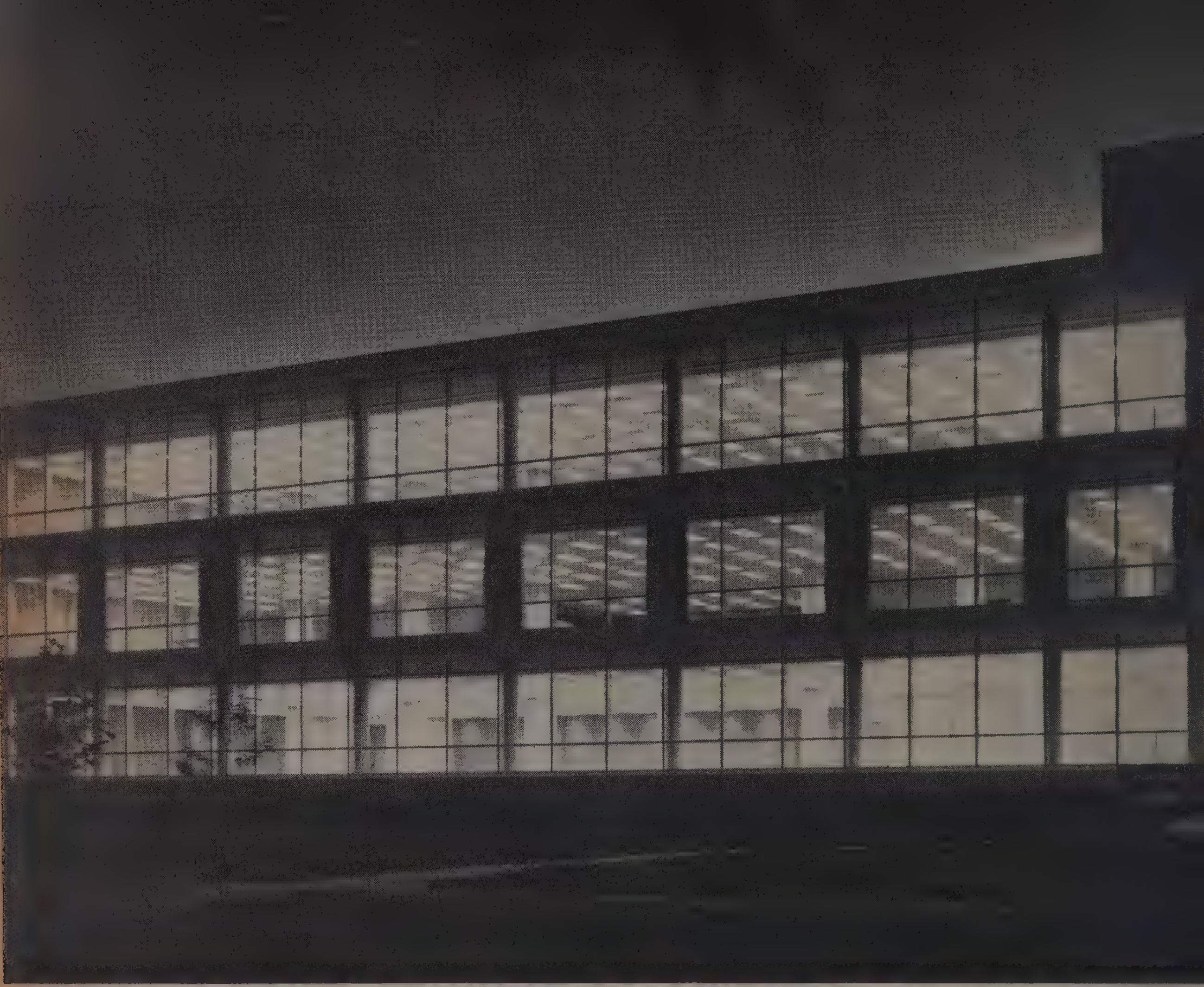
UNIVERSITY HALL, University of Calif., Berkeley

Meet Jim Mahaney, seasoned veteran of 22 years in the electrical construction field . . . superintendent for the Coopman Electric Company; contractors specializing in complex commercial and industrial electrical installations. Jim, who has supervised some of the most interesting jobs in the West, insists on quality products . . . like those manufactured by Efcor, for a trouble free job.

For instance, in the University of California's new University Hall, Jim and his men have used Efcor fittings and boxes in an installation that they will be proud of for years. Men like Jim Mahaney take pride in their work **. . . the men who really know— know Efcor.**

EFCOR

ELECTRICAL FITTINGS
CORPORATION
WOODSIDE 77, NEW YORK

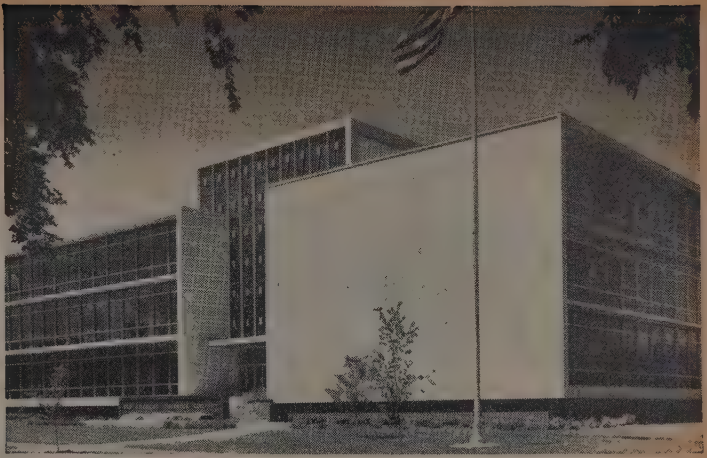


More than 1800 fluorescent fixtures in Old American's new building help create this striking nighttime impression.

Architects: Voscamp and Slezak
Mechanical Engineers: Scott and Kinney

110 footcandles of glare-free illumination are maintained throughout, including this attractive lounge for employes.

odular design, incorporating Day-Brite Mobilex®
ith Cleartex® enclosures, permits complete
exibility in arranging offices and work areas.



How Old American Insurance Co. ended the great lighting search with Day-Brite

True to Missouri tradition, Old American Insurance Co. adopted a "Show Me" attitude when considering lighting for their new Kansas City headquarters.

Working closely with their architect and consulting engineer, they contacted their local power and light company engineers. Consulted the experts at General Electric's famed Nela Park. Even made their Addressograph Department a "lighting laboratory" and installed competitive fixtures side-by-side.

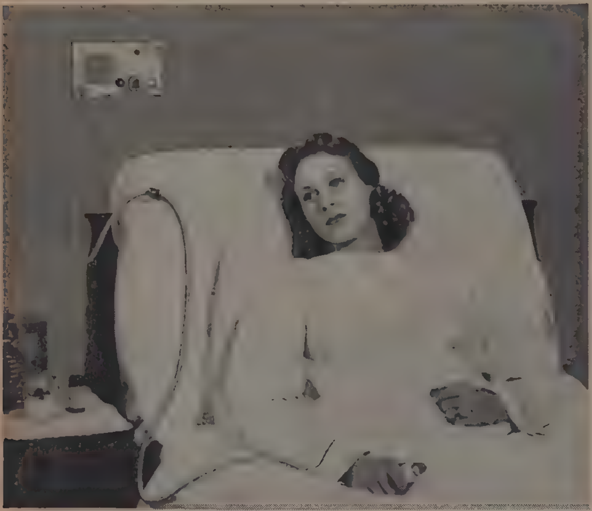
Result? For lighting effectiveness with high visual comfort, over-all economy with trouble-free maintenance, and pleasing appearance, Day-Brite lighting was the clear-cut choice.

May we show *you?* Call your Day-Brite representative, listed in the Yellow Pages, for the FACTS and FIXTURES! *Day-Brite Lighting, Inc., St. Louis, Mo. and Santa Clara, Calif. In Canada: Amalgamated Electric Corp., Ltd., Toronto 6, Ont.*

DAY-BRITE

NATION'S LARGEST MANUFACTURER OF
COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT

Thousands of Firms Have Profited from AUTH SIGNALING EQUIPMENT!...Has Yours?



FOR HOSPITALS: *Nurses' Call, Doctors' In-and-Out, and Paging Systems; also, Clock, Fire Alarm Systems, and Ground Detectors.*

FOR SCHOOLS: *Centralized Clock and Program Bell Systems; Fire Alarm Systems; and Products for Vocational Training.*

FOR APARTMENTS: *Apartment House Telephone and Bell Systems: also, U.S. Approved Mail Boxes and Non-Electric Door Chimes.*

FOR INDUSTRY: *Supervisory Annunciators, Audible Signals, and Push Buttons; also, Fire Alarm and Clock Systems.*

The name AUTH on electrical signaling, time, and communication equipment conveys different meanings, all of which can be summed up in one word—profit!

To owners—and their representatives, the architectural and engineering firms—Auth stands for capable assistance in planning requirements, excellent product performance, and minimum upkeep.

To distributors, Auth means easily-consumated orders at the right price—without rejections, delays, or excess paperwork.

To installing contractors, Auth represents well-made, dependable equipment specifically designed to simplify installation. They hook it up and walk away!

Everyone profits when fine equipment—as made by Auth—is specified, purchased, and installed.

If your firm hasn't had experience with Auth signaling equipment, why not start now? An Auth representative will be delighted to be of service. Please call him on your next job. No obligation, of course.

Auth

Auth Electric Company, Inc.
LONG ISLAND CITY 1, NEW YORK

SPECIALISTS IN ELECTRICAL SIGNALING AND COMMUNICATION SYSTEMS AND EQUIPMENT

McGILL®

Levolier®

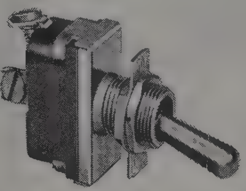
electrical specialties are

BUILT BETTER

to LAST LONGER

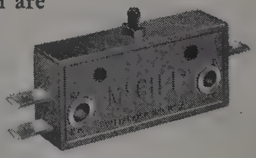
UNCONDITIONALLY GUARANTEED

The McGill No. 41 Levolier switch is unconditionally guaranteed against failure in lighting circuits. 6 amp. "T" 125 V. 3 amp. 250 V.

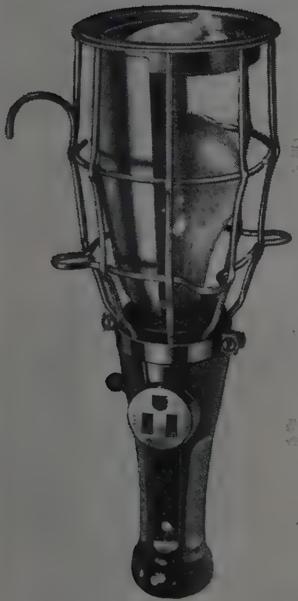


McGILL LEVOLIER SWITCHES

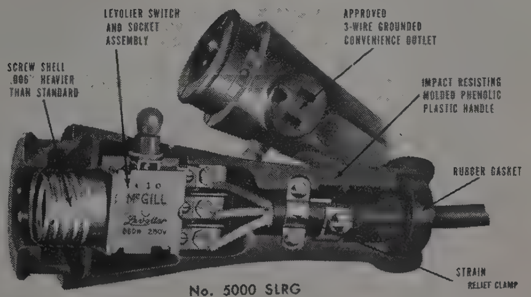
The same high standards of material selection and workmanship that make it possible for McGill to guarantee the No. 41 Levolier switch are applied to all McGill products. Levolier universal lever, toggle, momentary contact and special use switches from 3 to 20 amps have set performance records in a wide variety of uses. All are Underwriters' Laboratories, Inc. inspected.



McGILL PORTABLE LAMP GUARDS



McGill Lampguards are designed and built to withstand rugged industrial service. Top quality and careful workmanship assures a safe dependable light; where you want it, when you need it. Over 100 different types available including Grounded, Vapor Proof, and a variety of types of cages, handles and sizes.


LEVOLIER SWITCH AND SOCKET ASSEMBLY
APPROVED 3-WIRE GROUNDED CONVENIENCE OUTLET
SCREW SHELL .006" HEAVIER THAN STANDARD
IMPACT RESISTING MOLDED PHENOLIC PLASTIC HANDLE
RUBBER GASKET
STRAIN RELIEF CLAMP
McGILL
Levolier
660W 250V

No. 5000 SLRG

WRITE FOR McGILL ELECTRICAL SPECIALTIES CATALOG NO. 84

engineered electrical products

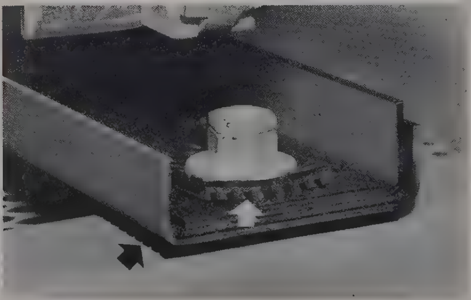
McGILL®

precision needle roller bearings

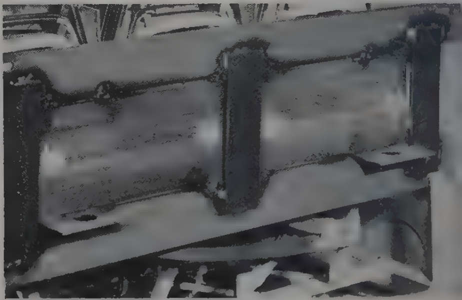
McGILL MANUFACTURING COMPANY, INC., ELECTRICAL DIV., 450 N. CAMPBELL ST., VALPARAISO, INDIANA

QHT* dry-type transformers

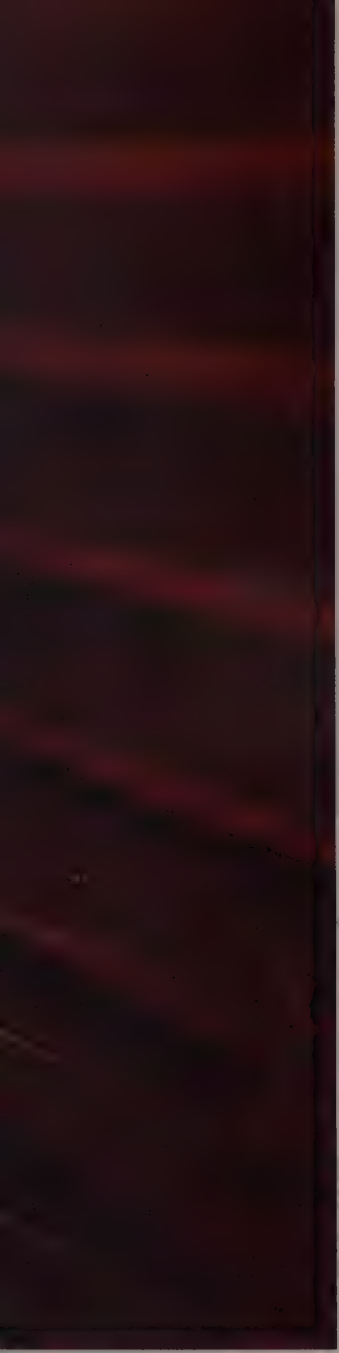
Research and testing in anechoic chamber of General Electric sound laboratory help maintain low sound levels of QHT transformers.



Built-in vibration-dampening rubber cushions isolate the rugged case of General Electric QHT transformers from core vibration, main source of transformer noise.



Welded steel clamps on higher ratings of General Electri QHT dry-type transformers keep the core lamination firmly in place to minimize vibration and reduce soun



How General Electric Designs "Quiet" Into QHT Dry-Type Transformers

Choosing the quietest transformer for schools, hospitals, office buildings, and other places where noise could be a problem is now easier than ever. General Electric's new line of QHT dry-type transformers is at least 15 decibels quieter than older designs, and the *actual rating appears on each transformer.* As the chart below shows, each rating of QHT transformers has a sound level equal to or less than the NEMA standard.

Full-time research and testing in General Electric's sound laboratory provide General Electric engineers with information needed to design and maintain the low sound levels of QHT transformers.

Vibration is minimized on larger size units by welded steel clamps which hold the transformer core in a rigid position. In addition, on QHT units rated 30 kva and up, vibration-dampening rubber cushions isolate the case from the core and coil assembly. Consequently, core vibration passing through mounting brackets and conduit to surrounding surfaces is practically eliminated.

QHT transformers also save production space because they offer savings up to 50 percent in weight and 67 percent in size compared with competitive dry-types. You can mount QHT units in out-of-the-way places near the load and save the cost of long, low-voltage feeders.

Installation is fast and easy. You wire QHT transformers from the front. Convenient dual-sized knockouts, large terminal compartments, solderless connectors, and numbered terminals save time.

You can get 24 hour delivery on most models from your nearby General Electric distributor. Call him for more information, or write for GEA-6907A "QHT Specifier's and Buyer's Guide" to Section 411-15, General Electric Co., Schenectady 5, N. Y.

**Registered trademark of General Electric Co., for quiet, high temperature, dry-type transformers.*

KVA	QHT DECIBELS†	NEMA STANDARD
BELOW 5	40	45
5–9	45	45
10–30	45	50
37½–112½	45	55
150	45	60
167	55	60
225–300	55	62
500	60	—

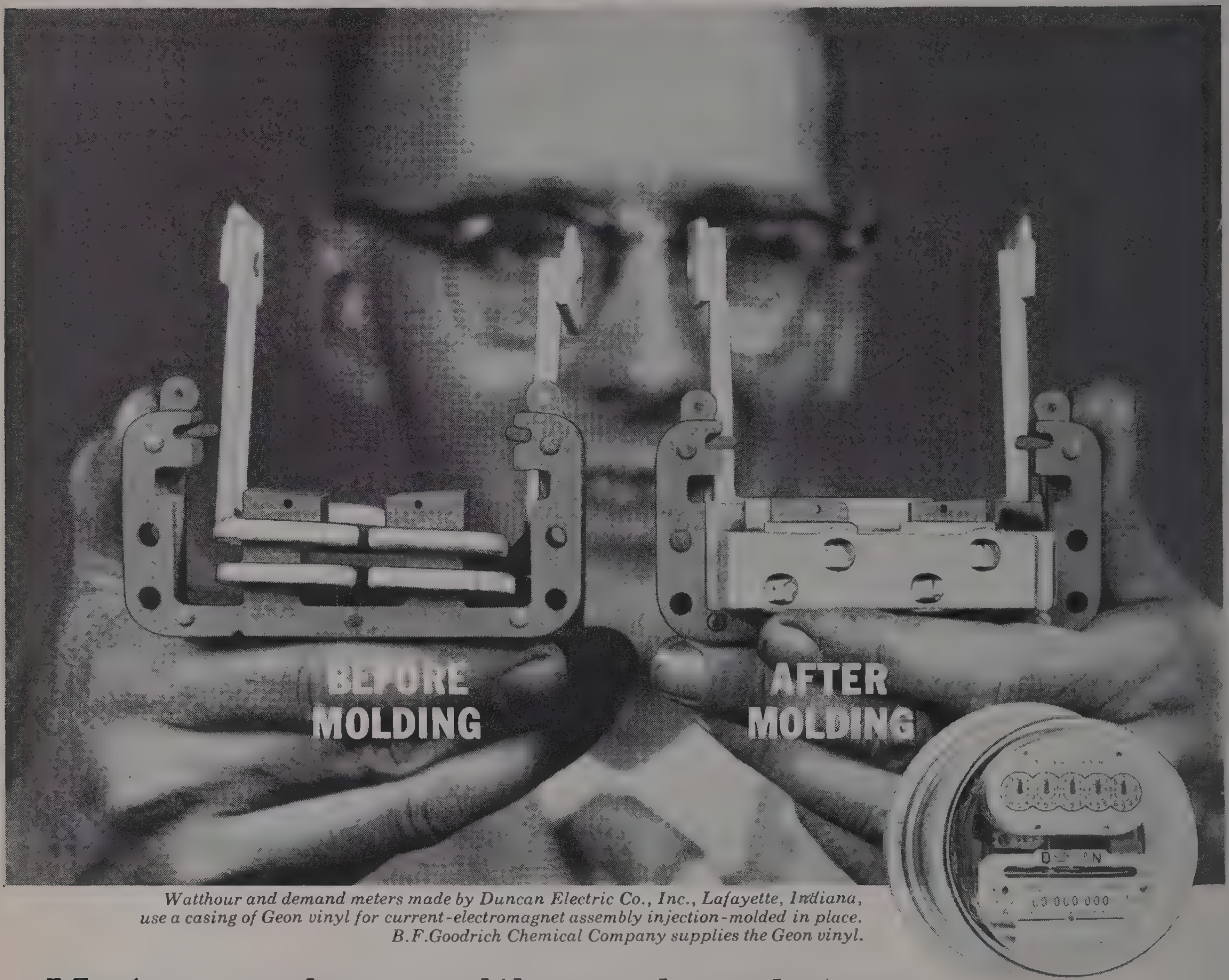
† Measured per NEMA Standard St. 1.411. The average office has sound levels from 55 to 65 decibels.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Another new development using

B.F.Goodrich Chemical *raw materials*



Watthour and demand meters made by Duncan Electric Co., Inc., Lafayette, Indiana, use a casing of Geon vinyl for current-electromagnet assembly injection-molded in place. B.F.Goodrich Chemical Company supplies the Geon vinyl.

Meter maker unitizes, insulates, and protects magnets with Geon

Geon vinyl does a three-way job for this meter manufacturer. By securing parts in position, providing insulation and protecting them against injury, Geon helps produce a better, longer lasting current-electromagnet assembly.

The manufacturer says that Geon exhibits excellent heat stabilization—it holds up well under high temperatures without exuding fumes that might corrode brass parts used in other areas of the meter. In addition, use of Geon made possible a less critical molding process, resulting in a more uniform finished piece.

Immediately after the molding process, high voltage tests of 7500 volts are made from turn to turn and from turn to ground—proof again of the outstanding electrical properties of Geon vinyl.

Here's another example of the way that products can be improved with Geon. Why many manufacturers are using it to open whole new markets. To get more information, write Dept. GY-6, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

Geon
VINYLS

B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

B.F.Goodrich

GEON vinyls • HYCAR rubber and latex • GOOD-RITE chemicals and plasticizers

QUALITY-SERVICE

Insuring top quality of all CADWELD Electrical Connection installations is the policy at ERICO PRODUCTS, INC.

Twenty CADWELD FIELD ENGINEERS continually assist new customers sold by the distributors throughout the country.

Here, R. G. Smith, CADWELD Southeastern District Sales-manager, personally instructs a construction crew foreman in CADWELDING a grounding grid system for a southern electric utility.

For the best in electrical connections—specify Cadweld

CADWELD®

electrical connections

ERICO PRODUCTS, INC.

2070 E. 61st Place Cleveland 3, Ohio
Distributed in CANADA by
CLM Industries—Toronto 13, Canada

HOW MANY AMPERES LURK BEHIND YOUR LOW VOLTAGE CIRCUIT BREAKERS?

FRONT VIEW
Shows the familiar K-Line escutcheon for electrical stored energy closing. Breaker also available with pulldown handle for manual stored energy operation. ▶

I-T-E's new K-Don® protects against fault currents up to 200,000 amp—plus giving you the complete range of K-Line circuit breaker operation

Suppose you have a low current fault. The K-Don circuit breaker element gives you time delay tripping. Or a medium current fault. You get instantaneous tripping. And for really high-capacity faults, you have the current-limiting action of Amp-trap® fuses in series with the breaker.

MAXIMUM FUSE ECONOMY

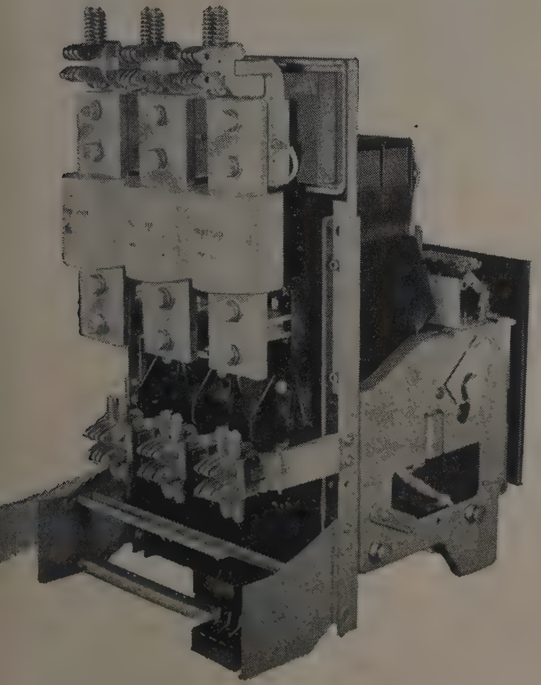
Only the I-T-E K-Don gives such complete protection—circuit breaker protection over the standard circuit breaker range and economical fuse protection from there on up to 200,000 amp. The only time fuses blow is when fault current is too high for the circuit breaker to handle. The K-Don is not a fuse hog.

NO SINGLE PHASING

The K-Don gives you this double protection all in a single compartment—saving you cost and bulk. And regardless of the type of fault, all three phases open every time. No single phasing to cause costly equipment damage.

COMPLETE RANGE OF RATINGS

Basically, the K-Don is a standard 600 volt K-Line circuit breaker with current-limiting fuses in series. Besides high current protection, you also get the advantages of expanded range trip and closed door drawout. Breaker ratings range from 30 to 1600 amp continuous, up to 75,000 amp interrupting. Versatility of protection is assured by a range of fuse ratings from 400 to 3000 amp. Drawout mountings are available in either Urelite® enclosures or switchgear assemblies. Write for detailed bulletin 4300-1A. I-T-E Circuit Breaker Company, 1900 Hamilton St., Philadelphia 30, Pa.



BACK VIEW

◀ Shows Amp-trap current-limiting fuses in series with circuit breaker. Fuses are on line side so they protect the breaker as well as connected equipment.

I-T-E CIRCUIT BREAKER COMPANY

Mr. Lester Olsen, Electrical Contractor for the Random Lake High School, Random Lake, Wis., says:

"Simplified wiring Clock System

Mr. Olsen stands beside the Honeywell Master Time and Program unit (ST 401, cover removed).

diagrams made the Honeywell a snap to install!"

Electrical Contractor: Lester Olsen; Olsen Electric of Wisconsin and Florida
Architect: Edgar A. Stubenrauch and Associates; Sheboygan
Engineer: Trester Engineering Company; Sheboygan and Milwaukee

Mr. Olsen found that installing the Honeywell Clock and Programming System at Random Lake High School was easy— thanks to Honeywell's concise, easy-to-follow engineering diagrams.

"We were pleased with the way Honeywell backs their Clock and Programming System with clear, concise wiring diagrams," says Mr. Olsen. "Our engineers had no installation problems whatsoever, and the entire job proceeded without a hitch."

Mr. Olsen adds: "By periodically checking installation procedures, Honeywell men helped us insure against costly wiring changes or corrections. What's more, we found the job of installing a Honeywell Fire Alarm System went smoothly, too. In fact, the same service and installation ease of the Honeywell Clock and Programming System is true of the Fire Alarm System!"

Mr. Olsen's story can be your story, too. You'll find that Honeywell's on-the-spot efficiency gets the job done quickly and correctly . . . by men *specifically* trained for the job. Why not call your local Honeywell office today? Let them tell you about the quality service that has made Honeywell *first in control* since 1885!

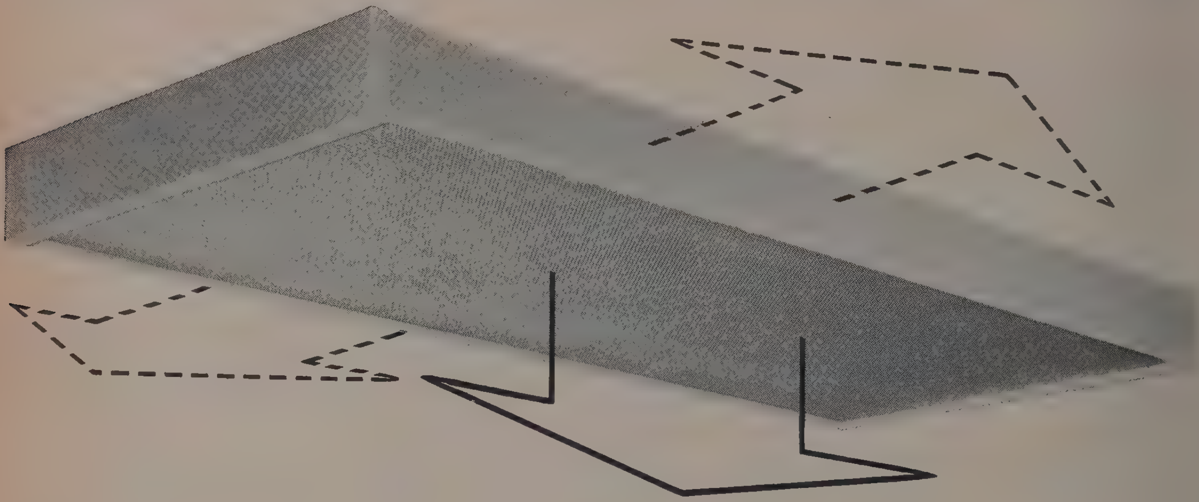
75 YEAR PIONEERING THE FUTURE

Honeywell

H HONEYWELL First in Control SINCE 1885

Workhorse with a thoroughbred look, Prismalux combines good, glare-free light output with trim styling . . . is ideal for such demanding applications as schools, offices, stores. An optically engineered prismatic lens directs controlled illumination downward, while diffuser sides provide soft peripheral lighting on ceiling areas. Thus brightness contrast is minimal. Both lens and sides are molded of styrene or Plexiglas into a single, sturdy unit for clean appearance, rapid installation, simple upkeep. Safety hinges along its full length permit easy access from either side, prevent accidental dislodging. Available either stem or surface mounted, in four or eight foot lengths, in two, three or four light widths. You'll find that appearance, performance and top quality construction are typically Lightolier.

PRISMALUX FOR GOOD, GLARE-FREE LIGHT



To learn more about Prismalux and other surface and pendant fixtures, write today for a complete brochure to Dept. EC10

LIGHTOLIER®

Jersey City 5, New Jersey / Showrooms: New York, Chicago, Dallas, Los Angeles

. . . for a better way of Light

Prismalux is stocked by these Authorized LIGHTOLIER Distributors:

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Harlo Elec. Sup. Co. Inc.
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Steiner Elec. Co.
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Springfield Elec. Sup. Co.
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Ft. Wayne:
Mossman-Yarnelle Co.
Gary:
Englewood Elec. Sup. Co.
South Bend:
Englewood Elec. Sup. Co.
IOWA
Des Moines:
Weston Lighting, Inc.
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NEBRASKA
Lincoln:
White Elec.
Omaha:
Electric Fix. & Sup. Co.
NEVADA
Reno:
Western Elec. Dists. Co.
NEW HAMPSHIRE
Portsmouth:
Mass. Gas & Elec. Light Co.
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Albuquerque:
The Lighting and Main. Co.

NEW YORK
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Niagara Falls:
Hysen Supplies Inc.
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Syracuse:
Superior Elec. Corp.
NORTH CAROLINA
Charlotte:
Independent Elec. Sup. Co.
Durham:
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Elec. Sup. & Equip. Co.
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Kinston Elec.
Winston Salem:
Noland Co.
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OHIO
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Gross Elec. Fix. Co.
Youngstown:
Mart Industries

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Oklahoma City:
Elec. Sup. of Oklahoma
OREGON
Portland:
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Brown & Green
Wally Elec. Sup. Co.
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Scranton:
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Pioneer Electric Dist.
Wilkes Barre:
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Pawtucket:
Major Elec. Sup. Co.
Providence:
Leavitt Colson Co.
SOUTH CAROLINA
Columbia:
Capitol Elec. Sup.
Noland Co.
Greenville:
Sullivan Hdwe. Co.
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Marlin Associates
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Strauss-Frank Co.
UTAH
Salt Lake City
Artistic Lighting

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Noland Co.
Lynchburg:
Mid-State Elec. Sup. Co., Inc.
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Noland Co.
Roanoke:
Noland Co.
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Clarksburg:
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Wheeling:
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Appleton:
Moe Northern Co.
Eau Claire:
W. H. Hobbs Sup. Co.
La Crosse:
W. A. Roosevelt Co.
Milwaukee:
Electri-Craft Lighting
Lappin Electric Co.
Standard Elec. Sup.
WASHINGTON
Seattle:
Seattle Lighting Fix. Co.
CANADA
Montreal:
L. D. G. Products, Inc.
The Gray Elec. Co.
Union Electric Sup. Ltd.
Quebec City:
La Cie Martineau Electric Co.
Toronto:
Revere Elec. Dist.
Toronto Ltg. Studios

Put PROVED dependability into interior FIRE ALARM systems!

You can provide today's *best* fire alarm protection for any industrial, commercial, or institutional building with a Gamewell FLEXALARM System. Thoroughly pre-engineered by the fire-protection professionals who developed the familiar "pull" fire alarm box, it assures the same unmatched efficiency and dependability *inside* buildings..

Precisely tailored to each installation, FLEXALARM is available as a coded or non-coded system, semi or completely automatic, with practically limitless possible combinations of annunciators, special drill, test, and alarm features. For example, it can be tied into the municipal alarm system at the curb; integrated with the sprinkler system; or automatic fire detection devices.

FLEXALARM is designed for unit-by-unit expansion depending on specific life hazards, fire defense plans and the growth of your plant. It's simple to specify, easy to install, efficient and economical. Gamewell will be happy to assist with fire detection engineering of new construction, expansion, or modernization, if desired. It's a service that gives you the benefit of over 100 years' experience with fire protection systems. Specify Gamewell . . . single source for engineering assistance and complete product line . . . maximum protection at minimum cost. Write THE GAMEWELL COMPANY, 1311 Chestnut Street, Newton Upper Falls 64, Massachusetts. *A Subsidiary of E. W. Bliss Co.*

BLISS
Gamewell®
FIRST...WHEN SECONDS COUNT

CONTROL

New! The most reliable limit switch ever developed

(from your Cutler-Hammer distributor, of course)

Limit switch failures cause more production down time than any other component. Suddenly this problem has been greatly reduced by the new Cutler-Hammer oiltight limit switch. Under test conditions much tougher than in actual production, these rugged switches lasted far longer than other makes tested.

Adaptable to any situation. The limit switch fits almost anywhere and in any position. A simple field adjustment changes switch operation to close the contacts by lever motion that is clockwise, counter-clockwise or both. And, no other switch is sealed more effectively. Even the silver-to-silver contacts are visible for quick inspection. Send for Pub. ED-143-U241 now for complete information.

What's new at Cutler-Hammer? We're planning ahead—for the big electrical boom coming in the next few years. We're developing new and *better* products, like the limit switch.

New distribution facilities mean better *and faster* product availability from your distributor. Cutler-Hammer sales engineers too are ready to help you with any electrical problem. Call when you want help. We're ready!

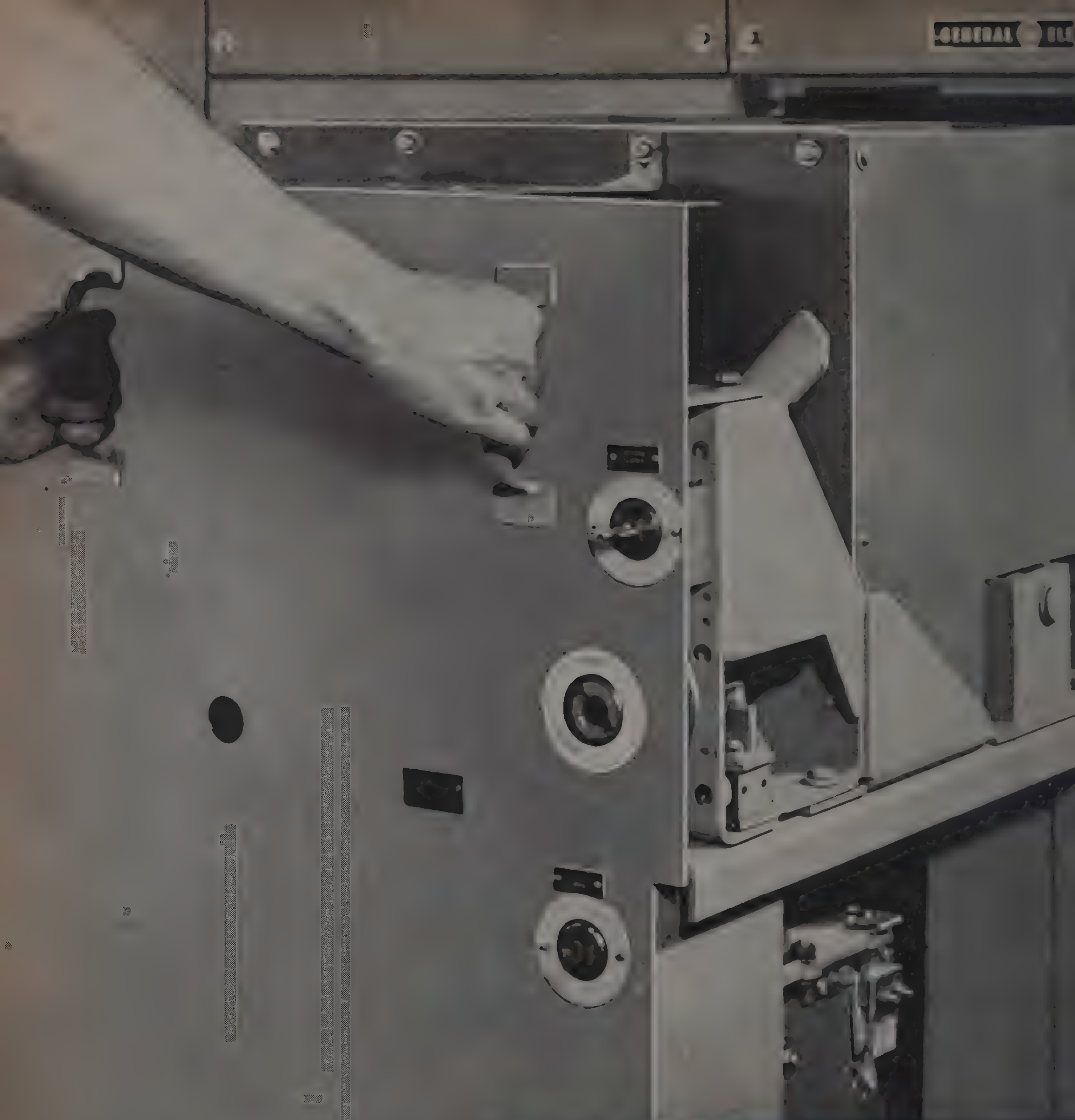
WHAT'S NEW? ASK...

CUTLER-HAMMER

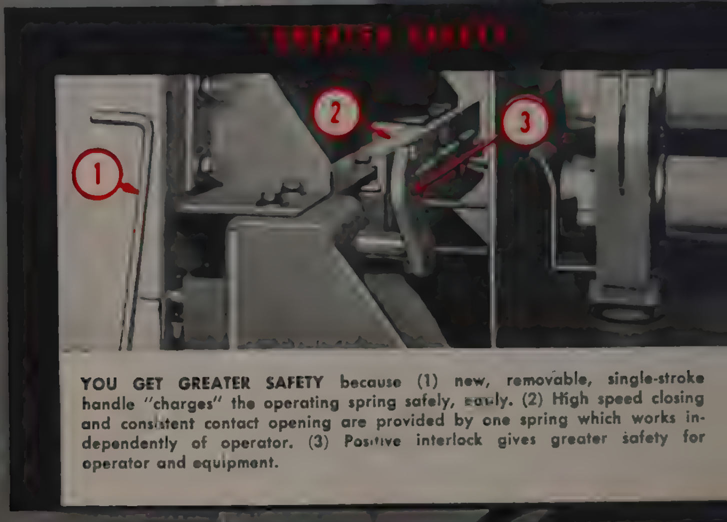
Cutler-Hammer Inc., Milwaukee, Wisconsin • Division: Airborne Instruments Laboratory • Subsidiary: Cutler-Hammer International, C. A. Associates: Canadian Cutler-Hammer, Ltd.; Cutler-Hammer Mexicana, S. A.

CONTROL

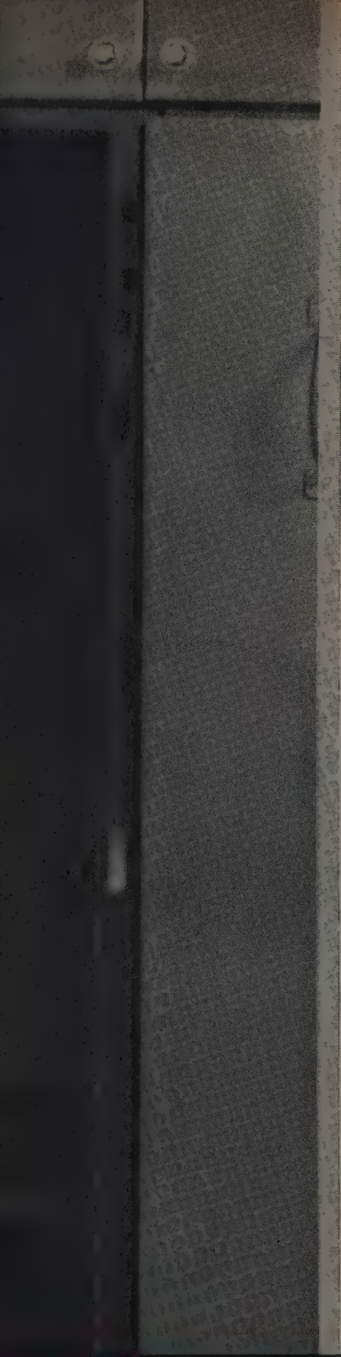
LIMIT SWITCH
NO.
WITH SELECTED OPERATOR
AMPERE RATINGS
VOLTS
AC
DC
AC INRUSH
115
15
0.5
40
230
10
0.2
20
460
6
—
10
600
5
.02
CONTROL
CUTLER-HAMMER



AS ACCESSIBLE AS A FILE DRAWER. G-E Roll-out Switch and Fuse Equipment (available in 2.4 to 13.8 kv ratings) combines maximum safety with ease of inspection and maintenance.



YOU GET GREATER SAFETY because (1) new, removable, single-stroke handle "charges" the operating spring safely, easily. (2) High speed closing and consistent contact opening are provided by one spring which works independently of operator. (3) Positive interlock gives greater safety for operator and equipment.



Here's how
General Electric
Rollout Switch and
Fuse Equipment makes...

THE BIG DIFFERENCE

in reducing fixed and operating costs for light duty switching and circuit protection

Greater safety, better short-circuit protection, easier installation, and reduced maintenance—these are the features of General Electric Rollout Switch and Fuse Equipment that play an important role in reducing your fixed and operating expenses.

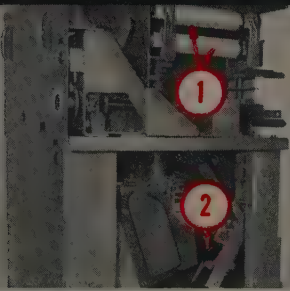
Precision-engineered components make another "Big Difference." A new manually-operated, stored-energy load-break switch provides both high-speed closing and consistent, sure contact opening independent of the operator. High quality current-limiting fuses and interrupter switches help assure rapid, sure switching and fault current protection.

Evaluate for yourself the difference this equipment can make in both commercial and industrial systems. For all the facts, contact your nearest G-E Apparatus Sales Office or write for bulletin GEA-6623B, General Electric Co., Schenectady 5, New York. 514-06

Progress Is Our Most Important Product

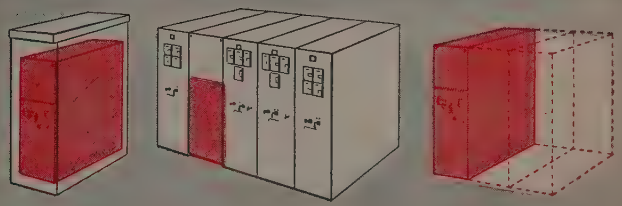
GENERAL ELECTRIC

TTER SHORT-CIRCUIT PROTECTION



GENERAL ELECTRIC ROLLOUT SWITCH AND FUSE EQUIPMENT has (1) current-limiting fuses on the source side of the (2) load-break switch. This feature means you get greatly improved short-circuit protection.

GREATER INSTALLATION FLEXIBILITY



YOU HAVE A CHOICE of construction types. G-E Rollout Switch and Fuse Equipment can be furnished to suit your installation needs—indoor or outdoor units; in line-up with G-E Metal-clad Switchgear; or in single or multiple units.

CLAYTON MARK

ONE SOURCE

FOR BOTH . . .

ALUMINUM
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STEEL
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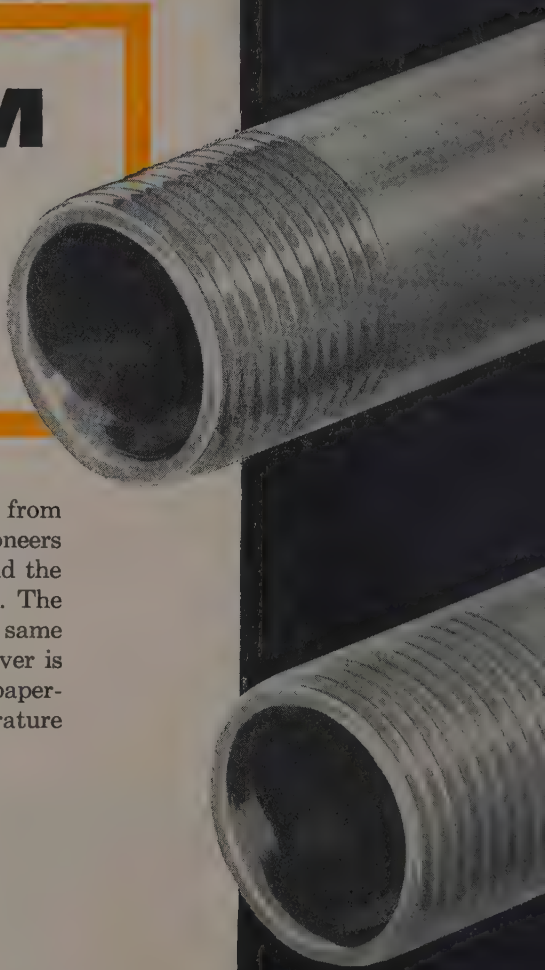

Now! You can buy *both* aluminum and steel conduit from one source of supply—Clayton Mark & Company! Pioneers in conduit since 1910, we offer the best, the safest and the longest-lasting conduit made under modern facilities. The availability of Aluminum Rigid Conduit from the same experienced manufacturer allows you to offer whichever is specified for the job . . . thus saving you duplicate paperwork, effort, time and money. Write today for literature and quotations on *both* aluminum and steel conduit.

"THE CONTRACTORS FAVORITES"

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RIGID ALUMINUM CONDUIT

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ALUMINUM CONDUIT

- Lightweight
- Corrosion-Resistant
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- U/L Approved
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- Durable and Sturdy
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- Wires Pull Through Easily
- Zinc-Coated Threads
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Raco has the most versatile and complete line of roughing-in material you'll find anywhere. Shown here are some representative products of our extensive line. One thing is sure—whatever size, whatever type of box or fitting you require, Raco has it.

And, of course, when it comes to quality, anyone who has used Raco roughing-in materials will tell you, "there are none finer".

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ALL-STEEL EQUIPMENT INC.
Aurora, Illinois

60TH YEAR • OCTOBER, 1960

ELECTRICAL
CONSTRUCTION
AND MAINTENANCE

Heating All Outdoors

Anyone seriously proposing heating an open loading area, the street outside a department store, hotel or theater, or an open grandstand with electricity only a few years ago would have risked the amused scorn of those skilled in heating application technology. The task appears to be preposterous with any practical fuel and almost fanciful with a costly energy source like electricity.

Actually the notion would be obviously impractical if we were to propose heating outside surroundings including the air. But providing warmth and comfort for people in these areas is a different problem entirely. Radiant heat can warm exposed surfaces in the line of sight directly and efficiently without loss in the intervening air however cold it may be. Thus the means of providing personal comfort outdoors can be simplified to a distributed source of radiant heat capable of supplying a portion of the body heat losses. With appropriate wind shielding any exposed area can be made comfortable.

Electricity is far the most effective energy source for the purpose. It can be almost entirely converted into useful radiant heat and is easily distributed and concentrated for optimum application. In practice the energy values for radiant comfort heating of exposed areas are quite reasonable. Typical applications take from 40 to 80 watts per square foot of area to be covered.

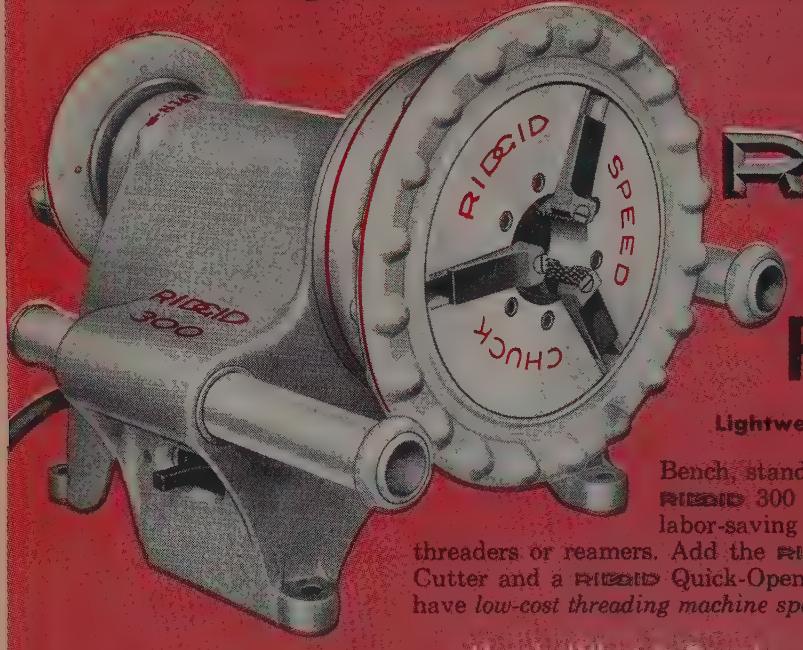
High capacity quartz infra-red heat lamps, thin tubular sources radiating about 100 watts per inch, simplify application. With specially designed reflectors, almost all of the energy is beamed accurately and usefully into the area to be heated. Installed like lighting fixtures the units are distributed to provide the desired area coverage with a minimum of waste radiation or spill.

Potential application of radiant comfort heating in exposed areas are almost endless. The few cited in our opening paragraph and many more are now in actual use. The method is applicable both indoors and out to many otherwise impossible or impractical comfort heating problems. But whether applied to a truck loading dock, a bus stop shelter, or a department store show window it opens up an entirely new market opportunity for the electrical industry.

Heating all outdoors, as we started out to say, borders on the fanciful. But radiant "people heating" outdoors has turned out to be both spectacularly effective and rigorously practical. It has to be experienced to be believed. A test installation in your own community will inspire plenty of novel application opportunities.

Wm. T. Stuart

Time-Saving Power For Your Shop or on the Job . . .



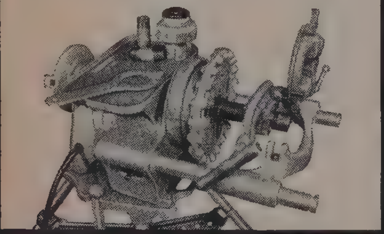
New RIDGID® 300 Power Drive

Lightweight • Versatile • Low in Price

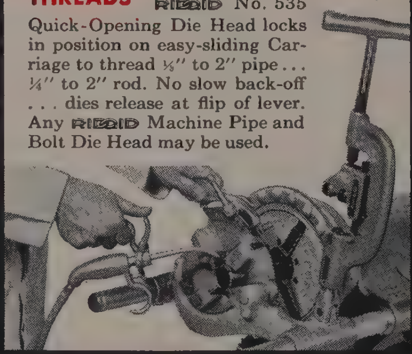
Bench, stand or truck mounted, this compact RIDGID 300 Power Drive gives you time and labor-saving power for your hand cutters, threaders or reamers. Add the RIDGID No. 310 Carriage, No. 360 Cutter and a RIDGID Quick-Opening Machine Die Head, and you have *low-cost threading machine speed and ease!*

Here's What it Does!

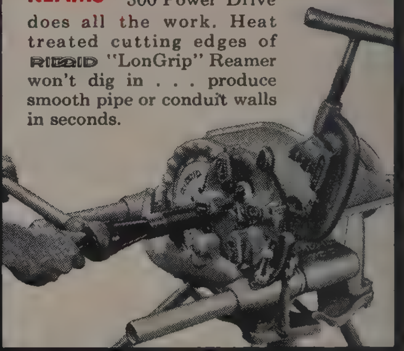
CUTS RIDGID No. 360 Cutter, shown here, cuts ⅛″ to 2″ pipe and conduit — up to ¼″ rod. Extra-wide rolls keep cutter straight for perfect high-speed tracking. Cutter stays back out-of-way when not in use.



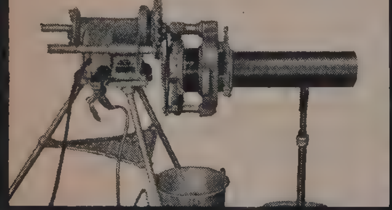
THREADS RIDGID No. 535 Quick-Opening Die Head locks in position on easy-sliding Carriage to thread ⅛″ to 2″ pipe . . . ¼″ to 2″ rod. No slow back-off . . . dies release at flip of lever. Any RIDGID Machine Pipe and Bolt Die Head may be used.

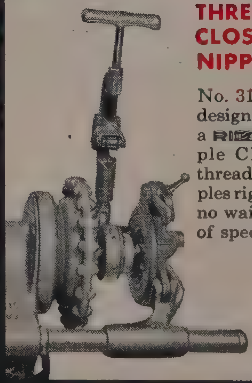


REAMS 300 Power Drive does all the work. Heat treated cutting edges of RIDGID "LonGrip" Reamer won't dig in . . . produce smooth pipe or conduit walls in seconds.



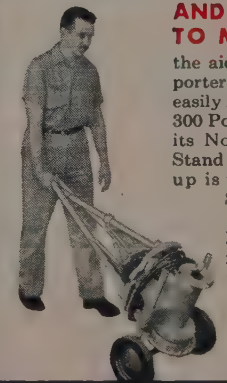
DRIVES GEARED THREADERS Compact, RIDGID No. 300 Power Drive has plenty of power for up to 12″ geared tools. New RIDGID Close-Coupled drive shown here, for Nos. 141 and 161 Jam-Proof Threaders eliminates Universal Drive Shaft . . . saves working space.





THREADS CLOSE NIPPLES

No. 310 Carriage is so designed that by using a RIDGID No. 19 Nipple Chuck you can thread even close nipples right on the job . . . no waiting for nipples of special lengths.



AND IS EASY TO MOVE With the aid of the Transporter, one man can easily move a RIDGID 300 Power Drive with its No. 1206 Folding Stand attached. Set-up is fast and easy. Stand's integral tool tray locks legs in position, forming rigid work base.

Save Time and Increase Your Profits on Every Job. See and Try This Biggest "Threading Machine" Bargain at your Supply House!

RIDGID®
The Ridge Tool Company, Elyria, Ohio, U.S.A.

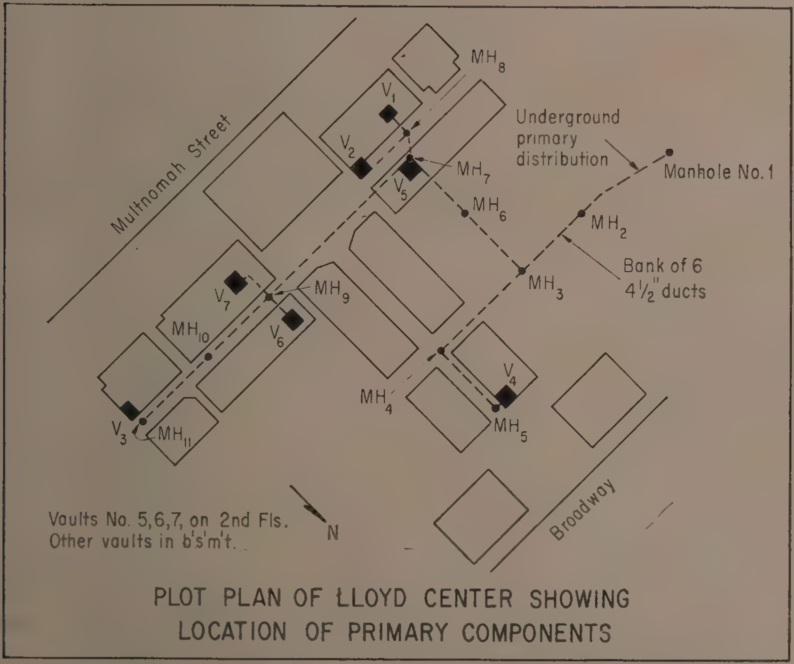
ELECTRICAL
CONSTRUCTION
AND MAINTENANCE

Basic distribution system for 14-building $30-million business-shopping center in Portland, Ore., features . . .

Mile-Long Bus Complex

Variety of low-reactance, weatherproof and plug-in busduct components; numerous mounting methods; routing complexity and bus assemblies rated up to 5500 amps are combined in extensive electrical plan. Initial power requirements of 20,000 kva are provided through seven substations. Three primary services at 11.8 kv serve each transformer vault via underground ducts.

By Clifton Tingley, Project Superintendent Lord Electric Company, Portland, Ore.

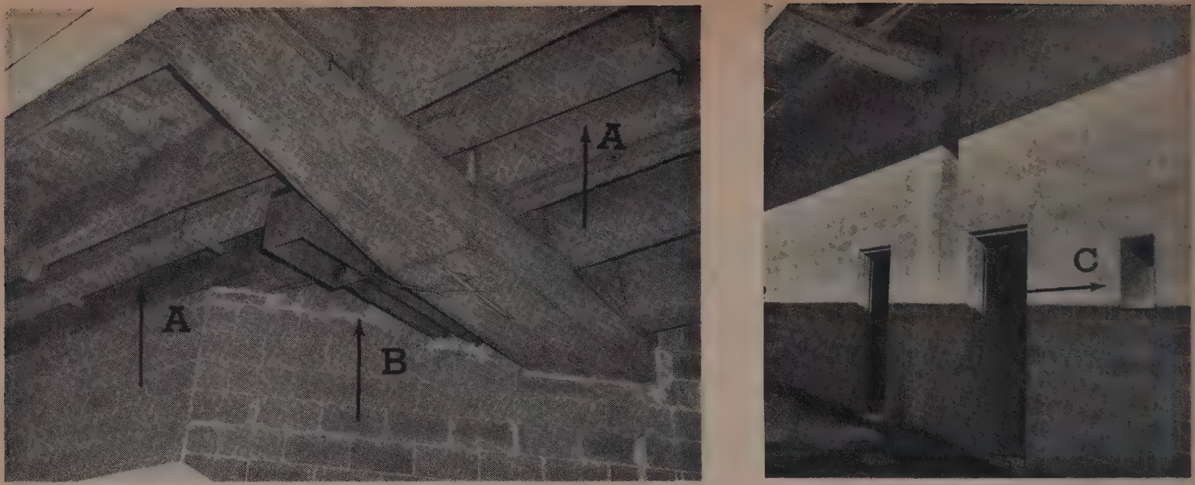

Multnomah Street
MH8
V1
V2
V5
MH7
Underground primary distribution
Manhole No. 1
MH6
MH2
MH3
Bank of 6 4½" ducts
MH9
V7
V6
MH10
MH4
V4
MH5
V3
MH11
Broadway
Vaults No. 5,6,7, on 2nd Fls. Other vaults in b's'm't.
N
PLOT PLAN OF LLOYD CENTER SHOWING LOCATION OF PRIMARY COMPONENTS

UNDERGROUND DISTRIBUTION system, serving each of seven load-center substations through three separate 11.8-kv feeders, has overall run of 2800 ft, the main duct bank consisting of six 4½-in. light-weight cellulous-fiber ducts impregnated with coal-tar pitch to resist acids, alkalies, heat, moisture and corrosion.

An IMPRESSIVE new integrated business-shopping development known as Lloyd Center has recently been completed in Portland, Ore. Consisting of swank department stores, retail shops, professional offices, restaurants, banks and markets, this vast center already contains 14 major structures, all of which are electrically served by a common 11.8-kv primary underground feeder system plus seven load-center transformer vaults and an extensive secondary busduct array that carries utilization-level 480/277- and 208/120-volt power to local control and switching stations in the premises of approximately 100 tenants.

This basic distribution system is as varied in nature as it is extensive, combining as it does, numerous busduct types, mounting mediums and installation methods. Scope of the project is suggested by the facts that busduct runs collectively exceed a mile in length, and that initial power requirements amounted to 20,000 kva.

Interest in this distribution sys-



BUSDUCT FEEDERS (A) are concealed and protected by canopies that overhang shop entrances. Power take-offs for small-tenant services are established via tap boxes, branch conduit being carried through building walls just below duct level (B), then dropping down inner walls to local control panels which are positioned back to back behind recessed meter ports (C).

tem is further sharpened by the fact that the electrical go-ahead was received four months *after* all other prime contracts had been let, indicating that duct and conduit work had to be installed *fast*, and that job engineering was therefore a high-pressure assignment, paced by crash-program delivery schedules.

Busduct Variety

As indicated by accompanying sketches, busduct runs variously include (1) low-reactance ventilated assemblies with capacities of 5500 and 4000 amps, four bars per phase interleaved as shown, and having full neutrals; (2) 3-phase 4-wire feeder assemblies (variously ventilated or weatherproofed) rated between 3000 and 1000 amps and having full neutrals and two bars per phase; and (3) 3-phase 4-bar plug-in busducts variously rated from 1000 to 40 amps. As noted, all bar terminals are silver-plated and slotted to receive connection plug-nuts. Feeder sections have removable covers, while covers of weatherproof sections are neoprene-gasketed and recessed into duct undersides to obtain effective preclusion of moisture.

Due to these varying construction details, as well as to the fact that busducts are variously mounted edgewise or flatwise, the suspension methods varied widely. For example, outdoor-located weatherproof sections are supported by trapeze channels, with ½-in. hanger rods secured either by masonry anchors in overhead concrete canopies, or held by reinforced brackets extending from structure walls.

Accompanying sketches indicate that trapeze channels and rod hangers are used to support interior standard (non-weatherproofed) feeder sections as well. Vertical rods being positioned snugly in contact with sides of ducts when edgewise mounting is prescribed; while triangular shoulder clips, formed from strap steel, are used to prevent lateral shifting of ducts in those cases where rods are moved outwards to permit greater freedom for cover removal, power-take-off connections and periodic cleaning.

Still another method for supporting flatwise-mounted busduct combines the use of wall- and ceiling-brackets with adjustable clamps that securely grip upper lipped edges of duct covers, thereby eliminating obstructions from beneath or around removable bottom cover sections.

Since many of these busduct runs radiate from four transformer vaults located at basement levels, and are therefore completely beneath main-floor slabs, it is apparent that rod hangers for such installations could be anchored conventionally beneath slabs, girders and joists.

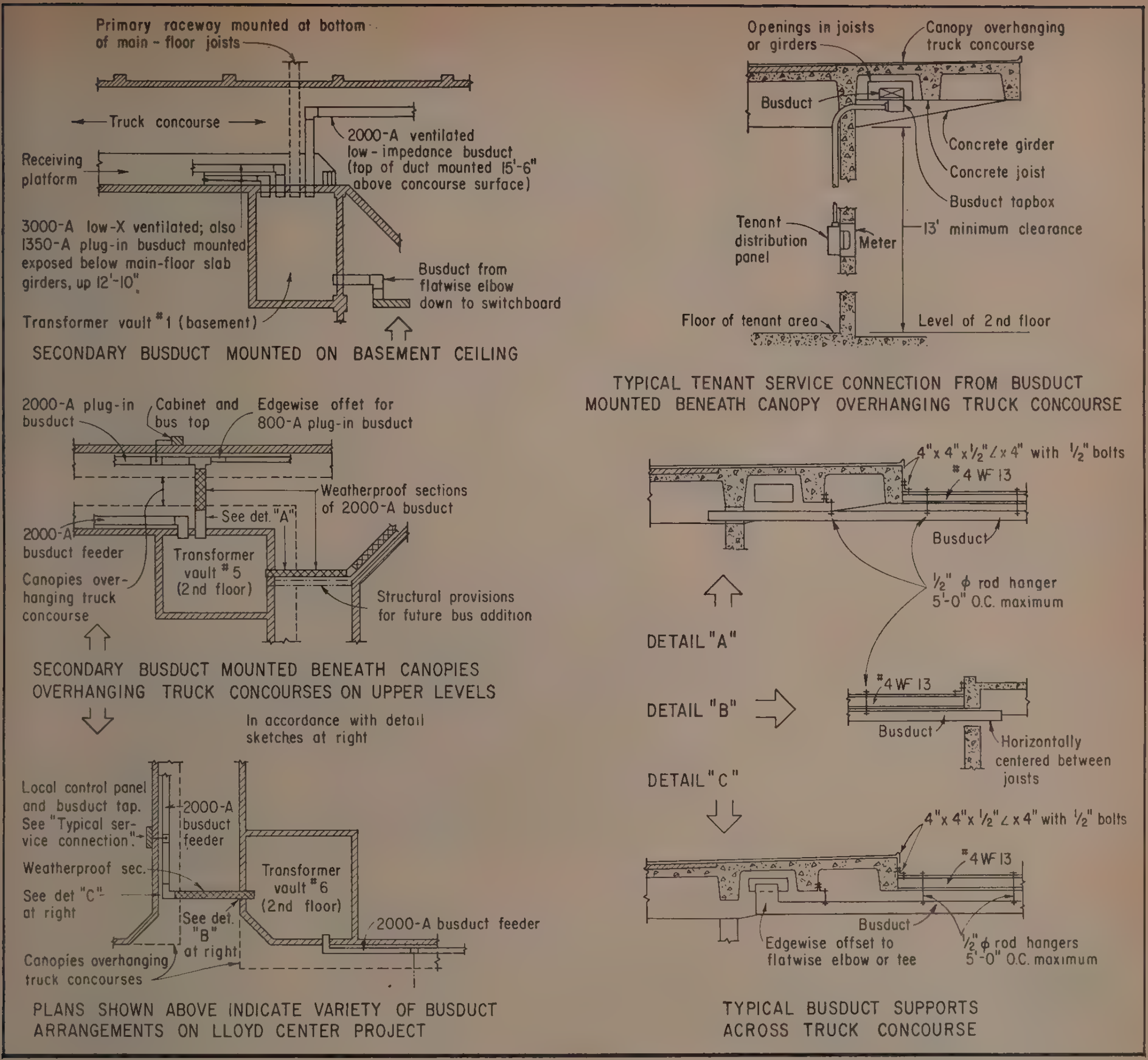
However, since busduct runs are also used to carry secondary power from three second-floor substations to shops located around upper-level open-air pedestrian malls (that also serve as truck concourses for merchandise delivery and pick up during other than normal shopping hours), it is equally apparent that additional mounting locations and methods were required.

Duct Concealment and Protection

Fortunately for the sake of duct protection and concealment, most of the shops that face the malls are surmounted by overhanging roof sections or canopies, with incorporated concrete joists running parallel to building fronts, and with tapered girders extending outwards from building faces at intervals to provide necessary joist support. By positioning busducts overhead, between building faces and the inboard joists of canopies, ducts are unobtrusively concealed from casual view, although they are readily convenient for tap-box connections at successive tenant-take-off points.

At girder locations where openings are required to permit duct passage, oblong holes were cut in girder webs. And, since weight of narrow canopy sections is minor, no additional web reinforcing was necessary.

In cases where it becomes necessary to carry busducts across open malls and concourses to reach walls of adjacent buildings, weatherproof busduct sections are used for these purposes. These ducts are suspended beneath wide-flange steel beams installed directly above them. As shown by sketch, ducts are supported by rod hangers with a maximum spacing of 5 ft, while angles and bolts are used to secure both rods and supporting beams


Primary raceway mounted at bottom of main-floor joists
Truck concourse
Receiving platform
2000-A ventilated low-impedance busduct (top of duct mounted 15'-6" above concourse surface)
3000-A low-X ventilated; also 1350-A plug-in busduct mounted exposed below main-floor slab girders, up 12'-10"
Busduct from flatwise elbow down to switchboard
Transformer vault #1 (basement)
Openings in joists or girders
Canopy overhanging truck concourse
Busduct
Concrete girder
Concrete joist
Busduct tapbox
Tenant distribution panel
Meter
13' minimum clearance
Floor of tenant area
Level of 2nd floor
2000-A plug-in busduct
Cabinet and bus top
Edgewise offet for 800-A plug-in busduct
Weatherproof sections of 2000-A busduct
See det. "A"
2000-A busduct feeder
Transformer vault #5 (2nd floor)
Canopies overhanging truck concourse
Structural provisions for future bus addition
4"x 4"x ½" ∠ x 4" with ½" bolts
#4 WF 13
Busduct
½" ϕ rod hanger 5'-0" O.C. maximum
DETAIL "A"
DETAIL "B"
DETAIL "C"
#4 WF 13
Busduct
Horizontally centered between joists
In accordance with detail sketches at right
Local control panel and busduct tap. See "Typical service connection".
2000-A busduct feeder
Weatherproof sec.
See det "C" at right
See det. "B" at right
Transformer vault #6 (2nd floor)
2000-A busduct feeder
Canopies overhanging truck concourses
4"x 4"x ½" ∠ x 4" with ½" bolts
#4 WF 13
Busduct
Edgewise offset to flatwise elbow or tee
½" ϕ rod hangers 5'-0" O.C. maximum

SECONDARY BUSDUCT MOUNTED ON BASEMENT CEILING

TYPICAL TENANT SERVICE CONNECTION FROM BUSDUCT MOUNTED BENEATH CANOPY OVERHANGING TRUCK CONCOURSE

SECONDARY BUSDUCT MOUNTED BENEATH CANOPIES OVERHANGING TRUCK CONCOURSES ON UPPER LEVELS

PLANS SHOWN ABOVE INDICATE VARIETY OF BUSDUCT ARRANGEMENTS ON LLOYD CENTER PROJECT

TYPICAL BUSDUCT SUPPORTS ACROSS TRUCK CONCOURSE

SECONDARY BUSDUCTS, radiating from basement-based substations, are suspended conventionally beneath structural slabs and girders, while ducts serving shops facing upper-level open-air malls are concealed and protected by placing them between concrete joists of overhanging canopies. Where busducts span malls and truck concourses, weatherproof sections are suspended beneath wide-flange bridging beams.

to canopy joists and building walls.

To eliminate any possibility of duct damage due to being struck by high bodies of delivery trucks, clearance distances between concourse levels and duct bottoms are at least 14 ft.

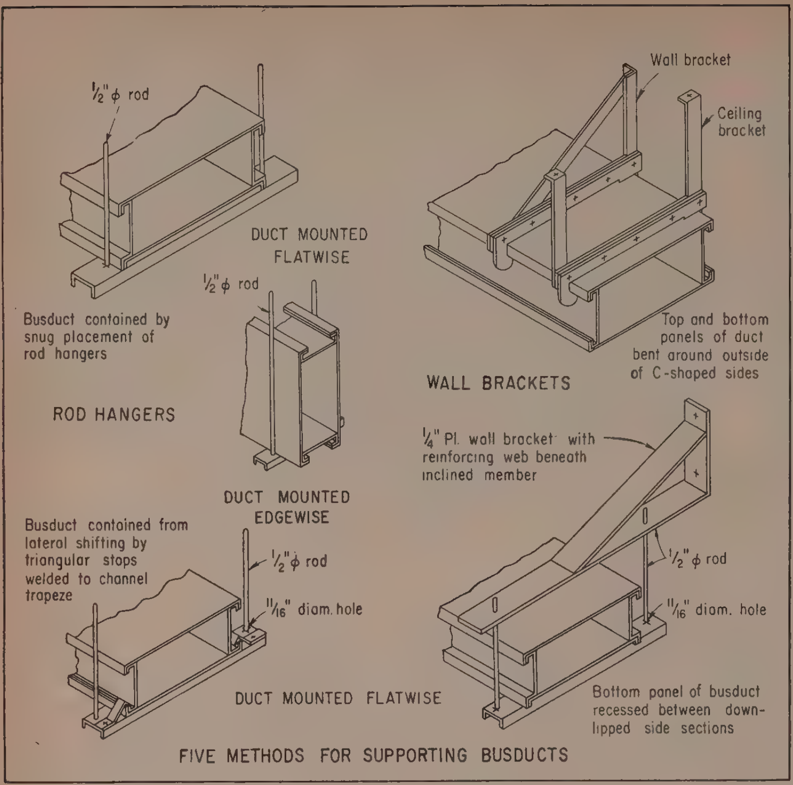
Where busduct tap boxes are positioned for tenant service, connections between exterior take offs and interior or local control panels are established via cable in conduit. Conduits are carried horizontally from tap boxes, through building walls at elevations just slightly below busduct levels, then down to the interior panel points.

It should also be mentioned that tenant distribution panels are mounted back to back with related meters located in recessed wall pockets. Such an arrangement makes it possible to read meters quickly and easily from outside the buildings.

In addition to the variety of busduct types used, plus various mounting positions and assorted methods used for supporting components, this installation was further complicated by the fact that walls of buildings and malls are not consistently parallel or at right angles to one another. Therefore, besides involving a liberal assortment of duct sections, tap boxes, end closures, wall sleeves, transition and reduction sections, expansion joints and fused switch adapter cubicles, it was also necessary to consider other than right-angle horizontal bends and offsets.

Installation Variations

Even inside of the seven transformer vaults, mounting methods varied considerably, inasmuch as transformers of several manufacturers had been specified. Dimensions and elevations of related network protectors were therefore not constant, while numbers of transformers within various vaults varied from two to six (with floor-space and secondary duct stubs provided for additional units if


½"ϕ rod
DUCT MOUNTED FLATWISE
½"ϕ rod
Busduct contained by snug placement of rod hangers
ROD HANGERS
DUCT MOUNTED EDGEWISE
Busduct contained from lateral shifting by triangular stops welded to channel trapeze
½"ϕ rod
11/16" diam. hole
DUCT MOUNTED FLATWISE
Wall bracket
Ceiling bracket
Top and bottom panels of duct bent around outside of C-shaped sides
WALL BRACKETS
¼" Pl. wall bracket with reinforcing web beneath inclined member
½"ϕ rod
11/16" diam. hole
Bottom panel of busduct recessed between down-lipped side sections
FIVE METHODS FOR SUPPORTING BUSDUCTS

NUMEROUS METHODS were used to support variety of busduct sections. Trapeze channels, rod hangers, clips, wall- and ceiling-brackets are combined to satisfy local structural conditions, to accommodate different dimensions or orientation of ducts, or to permit removal of duct covers for inspection, cleaning or connection of power take-off devices.

later found necessary). Also, due to local load conditions and sub-feeder arrangements, various vault arrangements called for different combination of busduct tap boxes for cable-conduit take offs, fused feeder compartments, plus bolted and/or flexible-braid connections between ducts, network protectors and transformers.

Due to the physical scope of the project plus the magnitude of electrical loads within specific structures, design engineers decided to distribute primary power through underground duct banks to seven load-center transformer vaults, with busduct sub-feeders (as previously discussed) then connecting with local distribution switchgear related to tenant premises, refrigeration equipment for an ice rink, a central heating plant, escalators, truck turn tables, air-conditioning equipment and parking-area lighting. Depending upon the size and nature of these various loads, distribution voltage supplied is either 208/120 or 480/277.

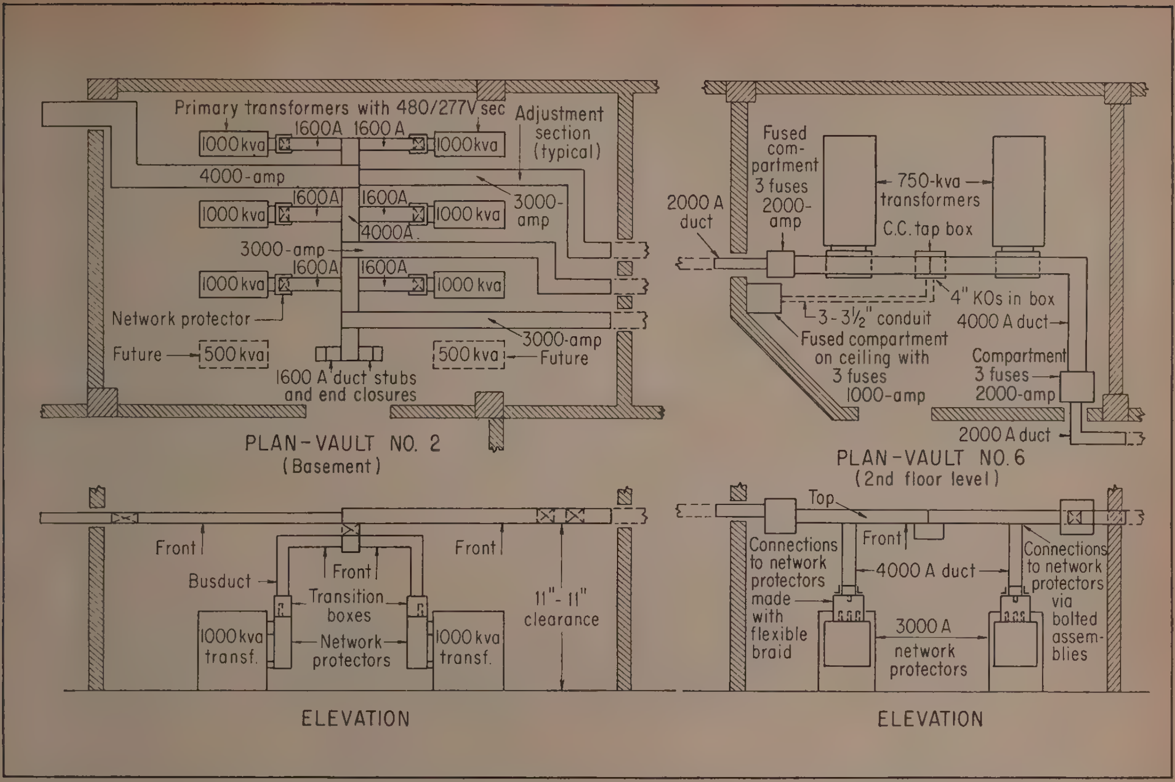
The seven transformer vaults were established in order to hold secondary bus sizes and lengths within reasonable limits and, since each vault constitutes a separate "spot" network system, secondary ties are unnecessary between vaults.

In calculating electrical demand, 13 watts per sq ft were allocated for lighting and air conditioning, plus a 20% allowance for growth.

Present total installed capacity of all vaults is 18,500 kva, with space and bussing provisions for extra units when required, and with present demand approximating 14,000 kw. Transformers are dry-type units and, although no prob-

ALL BUS RUNS from which small-shop taps are taken are classified as feeders, and therefore are fused in vaults, near tap-off points of main bus structures. In all cases, fuses are current-limiting types in order to provide adequate protection against faults in the bus as well as to provide overload protection to the bus. As pictured here, fuses are installed in hinged-cover enclosures mounted near the ceiling, while fuseholders are mounted on ebony-asbestos bases.

TRANSFORMER SECONDARIES in each vault are bussed together through network protectors, using low-impedance ventilated busduct that extends from the top of each network switch upward and across to the central bus, thereby obtaining a completely enclosed installation.



TRANSFORMER VAULTS, serving vast Lloyd Center business-shopping development, vary in their locations (basement and second-floor level), in their capacities (from 1000 to 6000 kva with provisions for additional units at a later date), in their busduct patterns (depending upon number and manufacturer of transformers) and in their inclusion of components (fused compartments, tap boxes, transition sections, etc.).

lems related to vibration or hum have arisen or are anticipated, they could be easily met and solved through the provision of additional sound-absorbing material on vault walls and vibration pads beneath transformers.

Transformers and primary feeders are sufficiently sized to preclude any power interruption due to failure of system components. That is, if one feeder or transformer failed, the remaining components could carry the full load during the period of normal repairs.

Transformers are equipped with dial-type thermometers with maximum reading indicators and circuit-closing contacts and, in the event of abnormally high temperatures developing, or of a network switch opening, a watch engineer at the utility company's remote supply substation could be so informed through related monitoring circuitry.

As indicated by accompanying sketches, transformer secondaries in each vault are bussed together through network protectors by using low-impedance ventilated busduct. It will also be noted that enclosed-type bus extends from the top of each network switch upward and across to a central bus section, thereby forming a completely metal-clad installation. Isolation of vibration between transformers and riser buses is obtained by providing (1) soft rubber gaskets between network switches and bus risers to prevent metal-to-metal contact, and (2) flexible copper-ribbon connectors between network switch and busbar terminals.

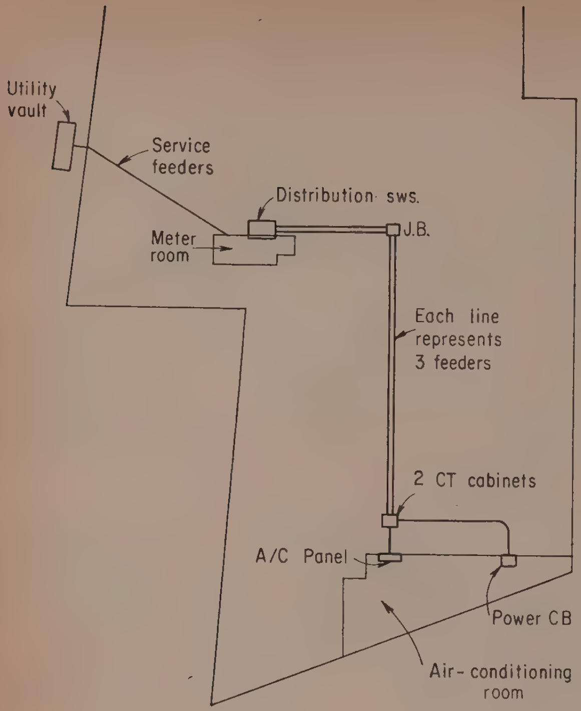
TO ISOLATE VIBRATION between transformer secondaries and feeder busduct, flexible copper-ribbon connectors are installed between network switches and busbar terminals. In addition, soft rubber gaskets are inserted between components of perforated metal protective housings (which were partially removed to permit clearer indication of connection details in this photo.)

Vaults are individually cooled by forced ventilation, air being drawn from and exhausted into fresh-air chambers.

Underground Primary at 11 KV

To serve the seven load-center substations, three 3-phase 11.8-kv feeders were specified. Each feeder consisted of three single-conductor 500 MCM 15-kv PILC cables, formed at the factory into triplex assemblies. Triplex design (rather than 3/c cables having a common lead sheath) was dictated by three considerations. (1) The possibility of sheath fatigue at manhole duct throats, caused by movement and bending of cables due to expansion and contraction under load cycling, would be lessened. In other words, rather than having the entire length-change of a rigid, straight 3/c cable transmitted longitudinally to duct ends, these increments of movement would be absorbed by the inherent flexibility

(Continued on page 252)



BASIC PLAN of feeders in basement shows supply from meter room to air conditioning mechanical room which is directly beneath the computer area on the first floor. The new service feeders consist of three sets of 500 MCMs, each in a 3½-in. conduit in concrete, and two extra 3½-in. conduits to meet load growth without having to tear up the slab again. In addition, there are eight original service feeders plus three more that were added at a previous modernization. The total of 14 sets of conductors are divided into two multiple-conductor feeders into two service disconnect switches.

Engineering skill solves . . .

Rewiring for Computers

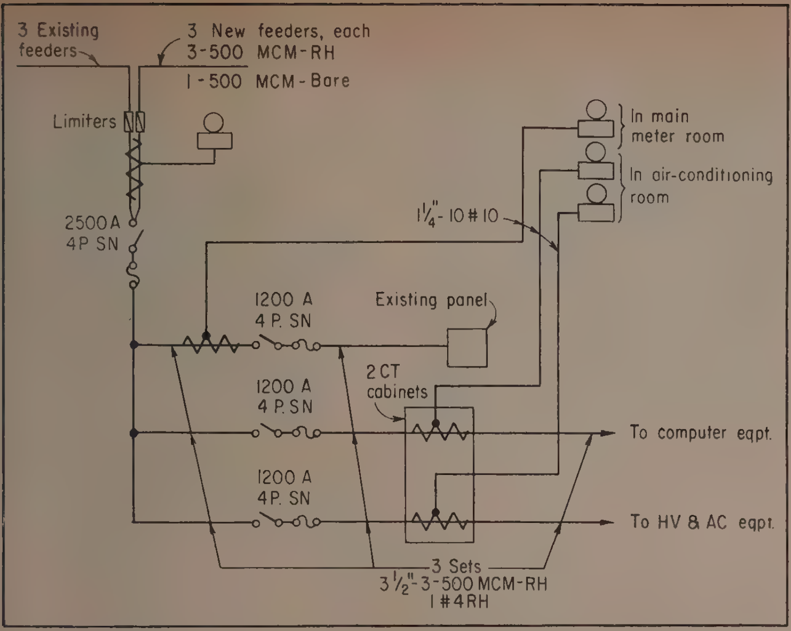
Installation of modern electronic computer equipment in an existing office building can pose a number of electrical design problems. Here's the way one such installation was worked out to supply an IBM 705 computer system in a Data Processing Center.

By Richard C. Kleinberger, *Consulting Electrical Engineer, White Plains, N. Y.*

ELECTRICAL modernization of space in an existing building to accommodate a data processing center involves wiring of a two part load. The major load is the total installation of electronic computer equipment. The secondary, but very substantial, load consists of the air conditioning equipment necessary to remove the heat load of the data processing machines and to provide a comfortable atmosphere for operating personnel. A typical example of such modernization is well represented in the headquarters of International Business Machines Corporation's Data Processing Division in White Plains, N. Y. A close look at this job reveals some interesting electrical details.

At White Plains, the data processing center is installed in attractively decorated space on the ground floor of the office building. The separate enclosed machines which make up the computer system are strategically positioned throughout the floor area. Electric energy is supplied to this load directly from main service equipment in a basement electrical room, as follows:

1. A 120/208-volt, 3-phase feeder from the basement electrical room is carried with an equipment



REVISED SERVICE plan for supplying the computer room and the heating, ventilating and air-conditioning load. The CT cabinet shown is mounted on the ceiling of the basement parking area, remote from the main service and meter room. The meters associated with these CTs are in the air conditioning room.

ground in conduit along the ceiling of an auto parking area below the ground floor of the building. In this parking area, the feeder runs through a ceiling-mounted CT cabinet which provides for separate metering of the computer equipment load. From the CT cabinet, the feeder is carried to a point in the basement just below the computer room. At this point, a manually-operated, 1600-amp, low-voltage power circuit breaker is wall-mounted and connected in the feeder run. Although the feeder run is protected by fuses in a 1200-amp switch in the electrical service room, this breaker provides co-ordinated overload protection and is equipped with a shunt-trip coil for remote tripping of the breaker from the computer room.

Pushbuttons of the momentary-contact type, strategically located on the walls throughout the computer area, are wired in parallel to energize the shunt-trip coil of the feeder CB when pushed. This arrangement provides for quick disconnect of all power to computer equipment in the event of any emergency condition which would require fast shutdown of the computers. To restore operation of the computers, it is necessary to manually reset the power CB in the basement.

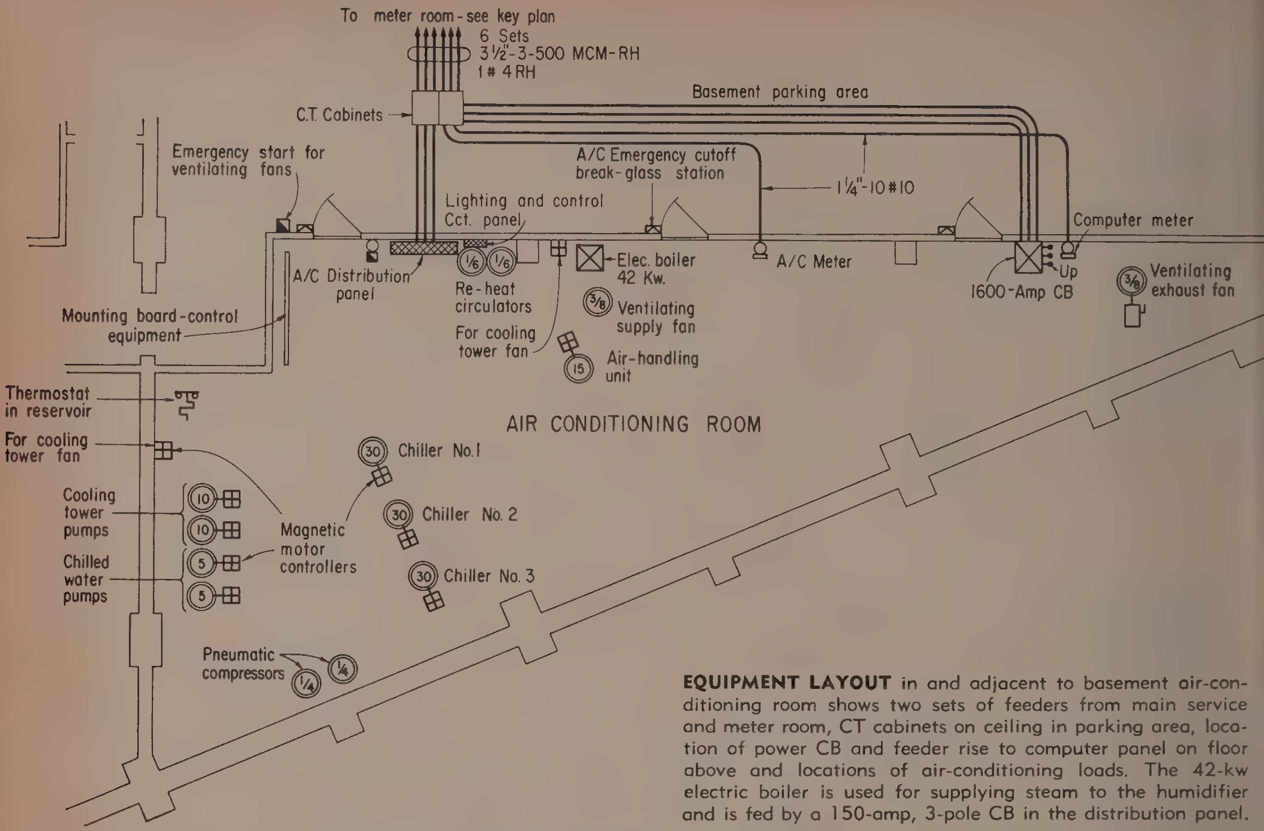
2. A power panel in the computer area is the single point of branch-circuit distribution to the individual computer machines. This panel, fed from the power CB in the basement is a specially-fabricated, dual-section, assembly recessed in one wall of the computer area. Bus for the two sections of the board are tapped from a single set of main bus-bars. Molded-case circuit breakers in the panel provide branch circuit overcurrent protection for the 208-volt, 3-phase, 3-wire circuits to the machines. And a substantial factor of load growth is provided in the sizing of the panel bus and by many spare breakers in the panel.

3. Branch circuits to the individual machines are run from the power panel under a raised floor which was installed 12 in. above the old floor of the area. Circuit runs consist of type RH conductors in flexible metal conduit run freely in the space under the floor to the machine locations. At the location of each machine to be supplied, the end of the flex supply circuit is equipped with a polarized, 4-pole cable receptacle connector. This connector, in each case, takes a matching plug installed on the end of the 3-phase, rubber-covered power cord from the IBM machine. The power cord from each machine is carried through a cable opening in one of the floor panels to connect to the flex circuit under the floor.

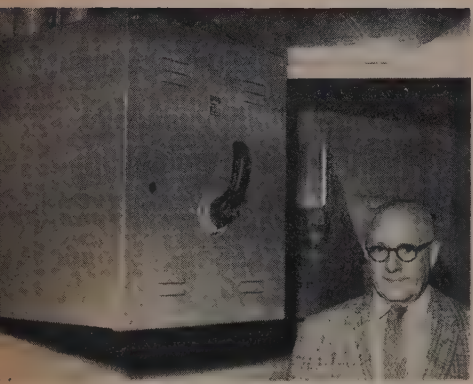
The use of a raised floor for electrical distribution in computer centers has come to be something of a standard. The method provides the flexibility and accessibility which are prime requirements of supply circuits to computer machines. Circuiting must make readily possible movement of machines and change in power concentrations over a wide area, as required by the nature of computer use. The use of flexible power cords with separable connectors for connection to flexible supply circuits answers part of the need. But, the raised floor—which makes possible the random running of branch circuits, answering the need for flexibility while preserving the neat showroom appearance of the computer area—is the real key to reconciling the many conflicting considerations.

The raised floor used here consists of 18-in. square, die-cast aluminum panels with a vinyl covering on the top surface of each panel. Adjustable pedestals set on the old floor support the corners of each floor panel, locking-in four corners

CT CABINETS mounted on ceiling of auto parking area in basement of building provide for separate metering of the computer load and the air-conditioning load. The two feeders—three 3½-in. conduit runs for each feeder—come from the right, from the main service and meter room. At the left of the picture, the 3-conduit feeder to the air conditioning power panel continues straight ahead. The 3-conduit feeder for the computer equipment makes a right-angle turn out of the CT enclosure. The 1¼-in. conduit shown is for metering conductors which are carried into the air-conditioning room.



EQUIPMENT LAYOUT in and adjacent to basement air-conditioning room shows two sets of feeders from main service and meter room, CT cabinets on ceiling in parking area, location of power CB and feeder rise to computer panel on floor above and locations of air-conditioning loads. The 42-kw electric boiler is used for supplying steam to the humidifier and is fed by a 150-amp, 3-pole CB in the distribution panel.



POWER CB in basement provides overcurrent protection for distribution panel in computer room above. Unit is equipped with shunt-trip coil which provides for remote operation of the CB from the computer area, to quickly disconnect all computer machines in any emergency. Author Kleinberger is at right.

COMPUTER PANEL, recessed in the wall of the computer area, has two sections which are bussed together and fed by three sets of 500 MCMs in flex from the power CB in the basement. As indicated by white labels only a few of the 3-pole CBs are used. Considerable load expansion is made possible by the spare CBs. Actually, these panels were designed before the load was known. In fact, design of the entire installation was done simultaneously with construction of the system—all on a crash program.

FLEXIBLE CONDUIT carrying the multiconductor feeder to the computer panel (3½-in. flex at left) and the outgoing branch circuits to the machines are shown here under the raised floor just in front of the wall-mounted computer panel. A few of the smaller circuits are made with armored cable to strategically-located 3-phase receptacle outlets on columns in the area. The flex and cable is laid freely under the floor and run directly to the points of load connection.

TYPICAL CONNECTION of a flex branch circuit to a rubber covered power cord from one of the computer machines is made by a 4-pole, polarized, separable connector. View here shows underfloor arrangement adjacent to a machine.

EMERGENCY DISCONNECT station is typical of such stations strategically placed in the building interior to provide cut-off of the air conditioning (at top) and remote tripping of the power CB controlling the computer feeder. The A/C cutoff is a break-glass station with a normally-closed set of contacts. Opening of these contacts breaks the control circuit to the 15-hp central air-handling unit and shuts down all other A/C equipment which has completely interlocked control circuits. If the air-handling motor starter opens, all other controllers lose control power and open immediately. The large mushroom button (at bottom) operates contacts in series with the voltage source and shunt-trip coil of the basement power CB. All such momentary-contact buttons are wired in parallel. To prevent accidental tripping of the CB, the button is protected by a plastic collar which requires direct, intentional application of pressure within the collar.

CONTROL INITIATION for the entire installation of air-conditioning equipment can be made from the START-STOP station (in the middle), mounted in the Customer Engineering room in the computer area. The START button closes the coil circuit of the magnetic starter for the central air-handling unit in the basement. Then, in the proper sequence, other A/C motor drives—cooling tower pumps, chilled water pumps, refrigeration compressors, pneumatic compressors, cooling tower fan, a 42-kw electric boiler and some smaller motors—are energized automatically and put on automatic cycling control in response to temperature pilot devices. Switch at bottom, here, is a 3-way toggle type providing control of an outside-air damper, with a second point of control on the basement A/C control board. Switch plate at top contains a pilot light for the air-handling unit and a pilot light for the outside-air damper—each indicating ON when lighted.

on each pedestal head. The panels on the pedestals hook together to make up a complete floor surface 12 in. above the old floor. The raised floor can take a uniform load of 275 lbs per sq ft and a caster load of 1000 lbs.

Wiring methods used for branch circuits in such a raised floor have varied from job to job. Although multi-conductor, neoprene-jacketed cables have been used on several jobs for branch circuit wiring from the power panel, it was decided in this case to use insulated conductors in flexible metal conduit. This is a standard NE Code wiring method, except that on this job the flex is not secured in place by straps or fittings as normally required.

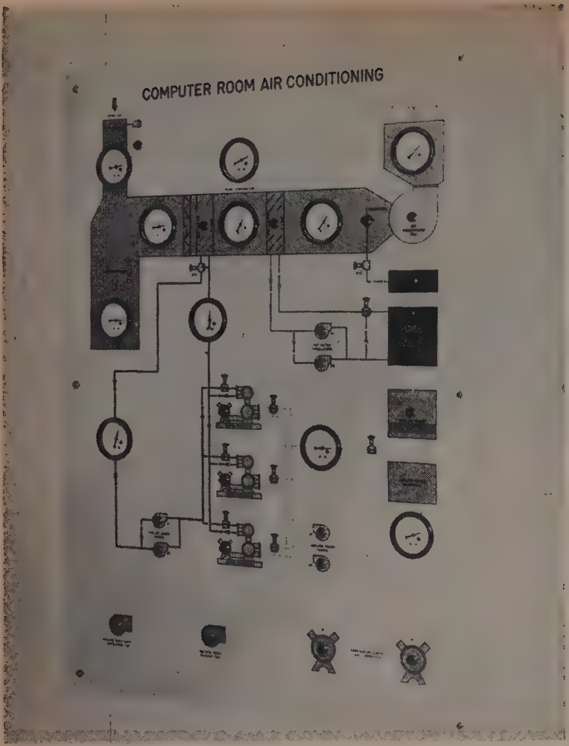
Grounding of the enclosures of the computer equipment is made by the fourth conductor in the power cord on each machine. This grounding conductor is connected through the separable plug-receptacle connector to a grounding conductor run with the phase conductors in the flexible metal conduit. In each branch circuit, the grounding conductor is the same size as the phase conductors to provide full-capacity in ground conductivity. At the computer power panel, all of the grounding conductors are connected to a single grounding bus. This bus is then grounded through three No. 4 RH conductors, one run with each of the three sets of three 500 MCM, type RH conductors in separate runs of 3½-in. flex from the power CB in the basement. Ground circuits are thus carried back to the common service ground in the electric service room.

Air Conditioning

An extensive air conditioning system was installed in the building to handle the heat load from the computer area. The major concentration of A/C equipment is in a basement mechanical room below the computer area. Design of power and control circuits for this system involved a number of interesting electrical details.

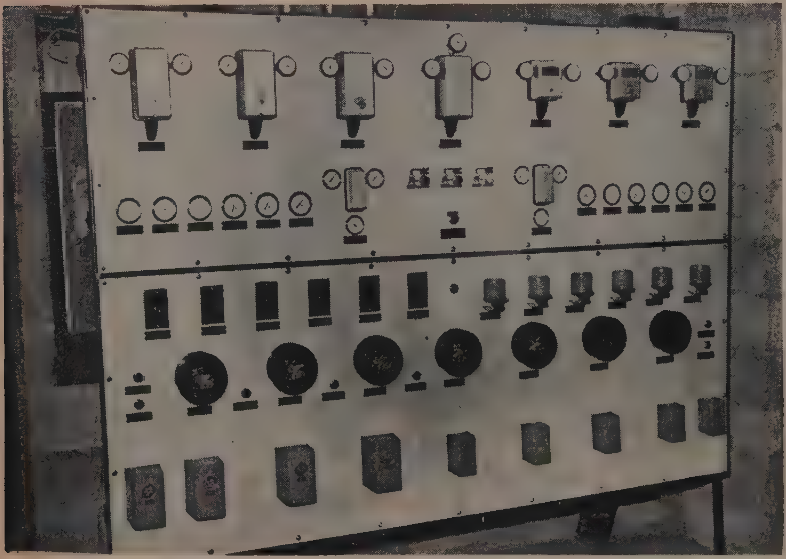
An electrical and pneumatic control system was devised for the air-conditioning and ventilating equipment to insure proper sequence of operation, and to provide necessary safety interlocks. The heart of this system is the control board just inside the west entrance to the machinery room in the basement. Dual points of control are provided —one on the control board itself and the other on the wall in the customer engineering room. The entire system can be either started or stopped from either of these two positions.

Without going into the intricacies of all the electrical controls, or the exact sequence of operations, it is sufficient to state that the primary object of control is the main air-handling unit. Operating the "Start" button at either control position will put the unit into operation. This in turn energizes a system of relays and other control devices that start the various other components of the system in the proper sequence. Included in these components is an air-intake fan and air-exhaust fan for the ventilating machinery room in the basement. In starting the system, no operation other than pressing the button is necessary—everything else is automatic. Similarly, operating either of the two "Stop" buttons will stop the air-handling unit, which in turn will stop everything



INDICATING PANEL in computer room diagrammatically represents the complete makeup of the air-conditioning system—showing the central air-handling unit at top right, steam generator for the humidifier in the duct, the hot water boiler for the heating coil in the duct, the refrigeration compressors for the cooling coil in the duct and various pumps, fans, etc. A pilot light within or adjacent to the symbol of each electrically operated unit is connected either across the load terminals of a motor starter or across a relay or solenoid coil to indicate operation of the unit.

BREAK-GLASS STATIONS just outside the A/C equipment room in the basement are associated with the completely interconnected, automatic control system. The station at left is a set of NC contacts in series with the starter operating coil for the air-handling unit. Opening of these contacts shuts down the complete A/C system. The station at right is a set of NO contacts which will provide independent operation of the supply and exhaust fans in the A/C room to clear the space in the event of refrigerant leakage.

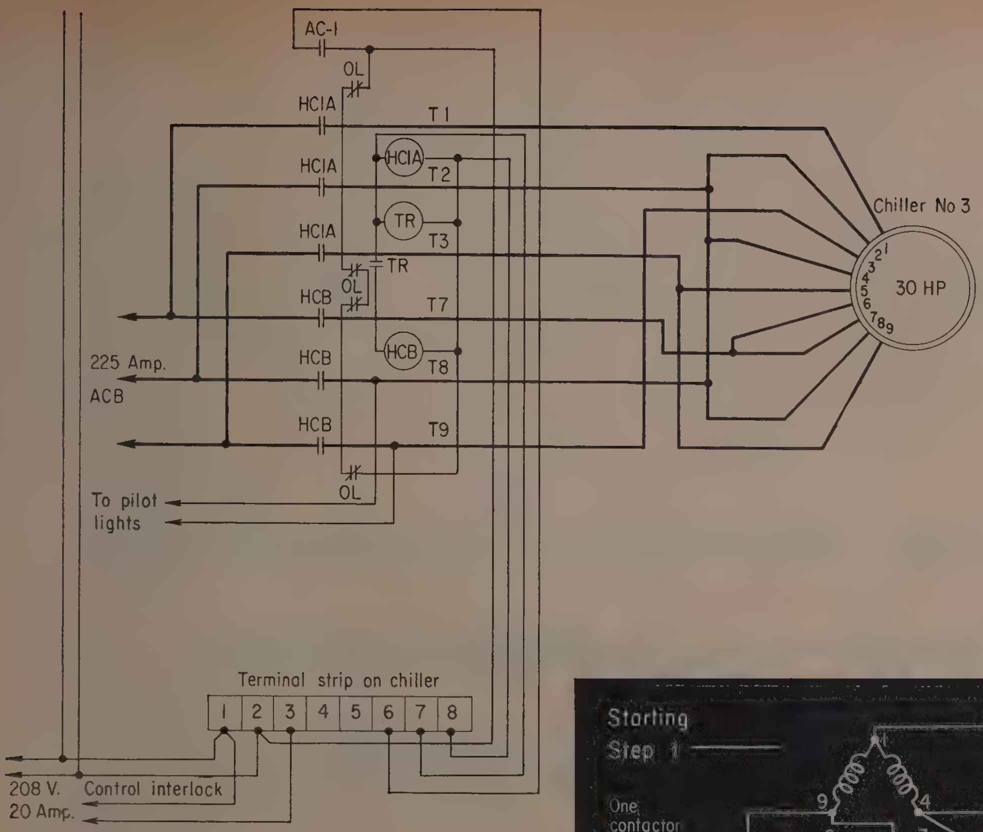


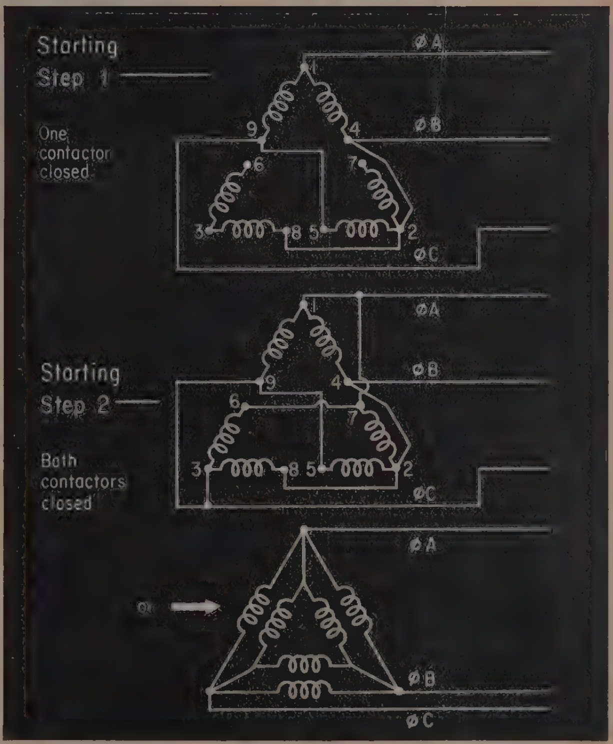
BASEMENT CONTROL of the A/C system is made from this panel in the A/C room. The electrical components are mounted on the lower part of the panel. The bottom row consists of various relays for interconnecting control circuits of the motor starters, pressure switches and solenoid air valves. The second row from the bottom contains pressure-operated switches which effect electrical control in response to pressure conditions of the mechanical system. The third row from the bottom contains selector switches and pilot lights at left, and six solenoid-operated air valves at right.

else. Exceptions to this are the two pneumatic air compressors. Depending upon the position of the selector switch one or the other of these units will always be energized, regardless of whether the main system is in operation or not.

To provide for a possible emergency, four break-glass stations are provided at various locations in the computer room and a break-glass station is provided just outside of each of the three doors to the basement machinery room. Operation of any of these seven stations will stop the air-handling unit and all attendant equipment. If such an emergency operation is performed, resetting of the break-glass station will *not* start the equipment automatically—it will be necessary to go to one of the two regular control points, as previously described. An additional automatic emergency stop for the air-conditioning system is provided by the fire-detection system, described later.

An additional break-glass station is provided just outside the west





PART-WINDING STARTER is used in the automatic A/C control system to bring in each 30-hp compressor, with low-level of line disturbance due to starting current inrush. At 208 volts, currents are high and line voltage is a more critical consideration than it would be at higher voltage. Each compressor motor has two separate delta windings which can operate independently. By energizing only one of the parallel windings on starting, the impedance of the motor is twice as high as it would be if both windings were energized simultaneously. The starting inrush current is thereby reduced. Then, when the motor is rotating, the second winding is connected in parallel with the first and load current is drawn. The two contactors in the starter are operated in time sequence by controlled delay in the operation of the second operating coil.

entrance door to the basement machinery room. Operation of this device will start the two aforementioned ventilating fans independently of the rest of the system. If an emergency should arise wherein refrigerant gas should escape from one or more of the cooling units and fill the machinery room, it would then be possible to exhaust these fumes to the outside air without entering the room. Resetting of this station will restore automatic control over these units.

To assure further safety of overall operation of the building system, interconnection is made between the building's fire detection system and the control system for the air conditioning equipment. If one of the fire detectors is actuated and trips the system, this interlock will shut-off the air-handling unit, which in turn will turn off the balance of the air conditioning equipment.

Accompanying illustrations cover major elements of the overall electrical job. Installation work was done by Whiffen Electric Co., White Plains. Abrams & Moses, New Rochelle, N. Y., were mechanical engineers on this installation.

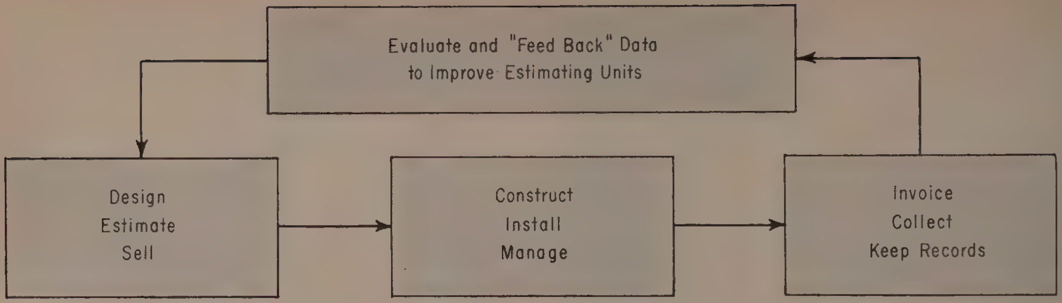


FIG. 1—Flow chart shows that data gathered from previous jobs provide valuable information for future jobs. The new multi-purpose worksheet, shown in Fig. 2, simplifies the process of maintaining permanent job records.

New Multi-Purpose Worksheets Aid Contractor

Proper worksheets for each job play a vital role in effecting sound business management through an adequate cost-determination and cost-control system. An electrical contractor describes a multi-purpose worksheet that he has been using successfully for over two years.

By **Otto W. Walther**, *owner, Walther Electric Co., Hughson, Calif.*

BECAUSE cost determination and cost control are important considerations in any business, it is obviously very important to know the exact cost for manufacturing a product or for providing a service. On bid or contract jobs it is equally necessary to determine the cost of material delivered and labor furnished in order to use the results for estimating purposes in the future.

Job cost determination and job control are easier to obtain than perhaps most contractors realize. Once the practice is established it does not require much more time than to bill the job, and much of the work can be done by the bookkeeper or store attendant.

In establishing a costing system the first requirement is to have all the information pertaining to a job readily available, such as:

1. Quantity and description of material used
2. Labor: man-hours and rate of pay
3. Direct Job Expense: sales tax, payroll insurance, permits, etc.
4. Overhead: either as a percentage of prime cost or as a fixed amount per man hour worked

To gather and assemble all these items, a multi-purpose form such as described in this article is ideally suited for small contractors and for larger contractors doing residential work (see Fig. 2). Not only does it provide room for the information mentioned, but it serves also as a work order, or work sheet and job envelope.

In Fig. 2, the front page of the worksheet serves the dual purpose of material list and invoice. There is adequate room for the complete address of the customer, job number, date, and room for the description of work to be performed. In the lower part of the form, the electrician lists the material used. This list may be started in the office, thereby indicating what material is to be taken to the job.

After the worksheet is returned to the office, the material is priced. List prices are entered in the columns to the left of the double line (front page of Fig. 2), cost prices to the right. On contract jobs where only the cost is needed, only the columns to the right of the double line are completed. For larger jobs, which require more space for listing material, a material-list continuation sheet is used. This is a single page, identical to that of the front page. The part to the left of the double line, including the heading, represents a detailed account of the job, plus serving as the invoice when copied on an invoice form. However, in most cases it is not necessary or advisable to itemize material and labor on the invoice sent to the client. Therefore, description of the work performed with the total amount, including material, taxes and labor in one lump sum, will simplify and shorten the time required for billing, and avoid arguments with the customer.

Work Order

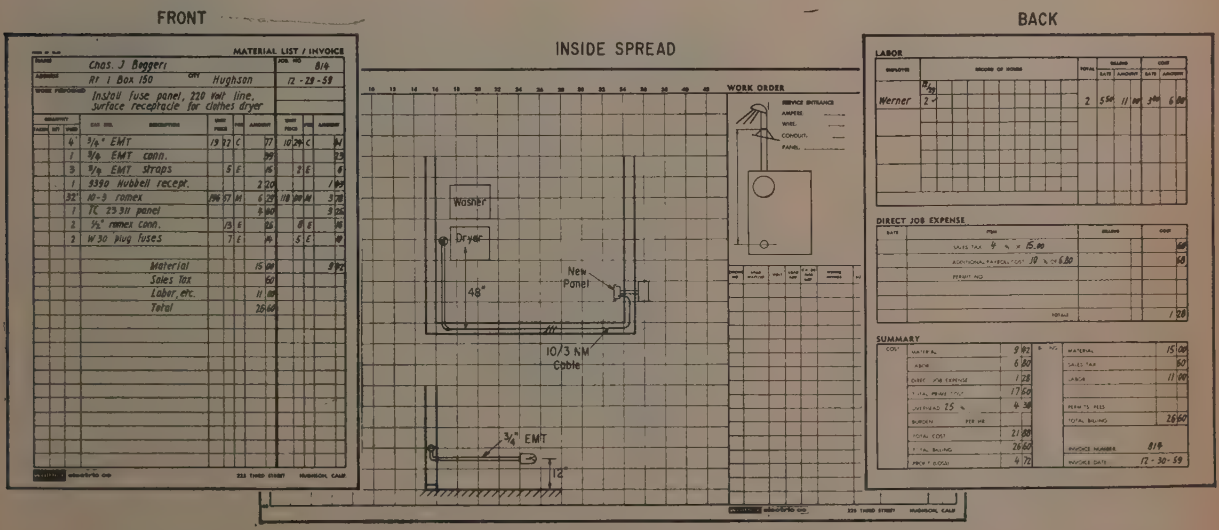
As shown in Fig. 2, the inside spread of the worksheet is a work order form, which serves to instruct the workman. And later it will be an accurate record of the job. Instructions, diagrams, layout and other job information may be prepared in advance. In most cases, however, it is preferable to draw and write all of the information while discussing the details of the job with the workman. Any questions that might come up can then be clarified in writing. If necessary, the location of the job can be indicated with the help of a quickly drawn map of the area. Additional information to guide the electrician includes: layout of service-entrance equipment; size and number of wires; size of conduits; wiring method; number and layout of circuits; and one-line diagrams of feeders or branch circuits. Ruled space is provided for a feeder or circuit schedule. For outlet locations, a floor plan may be drawn with the help of the guide lines, which are spaced 2 ft for a ¼-in. scale, 1 ft for a ½-in. scale, etc. After completing the work, the electrician should enter on the worksheet any changes or additions made in the layout of the job. Then the worksheet becomes an accurate and permanent record and may be used later to service the equipment or plan extensions to the system. If the form is folded inside out, it will serve as a job envelope with the customer's name and job number appearing along the top edge, ready for filing.

The back page, shown in Fig. 2, is completed at the office. In keeping the labor record up to date, enter electrician's name, date, and hours worked from the daily time cards. After a "C" or similar mark on the front page indicates that the job has been completed, the bookkeeper will extend the labor and material figures, determine direct job expenses, enter overhead or burden, and complete the summary. At this time, and before making out the invoice or inserting any journal entries, the owner should examine the entire job record. Here mistakes are now most likely to be found and can be easily corrected. Also, adjustments can now be made for additional work performed.

Most of the time a fixed percentage is added for overhead. If however, a high ratio of material compared to labor exists, or labor only is furnished, this method will not give the true costs. A fixed amount per man-hours worked (burden per hour) should be used here. On the other hand, if this is a contract or bid (lump sum) job, the amount of profit or loss is now apparent in the difference between "total cost" and "total billing." For a time and material job, a desired amount of profit is added to arrive at the total billing. Or, if material is itemized and charged at a list price, the amount billed may be adjusted by granting a quantity discount (on material only) to arrive at an adequate amount of profit. In case of a complaint by the customer, a glance at this summary will supply the contractor with the information needed to justify the amount charged and to correct any misunderstanding.

With the proper use of this multi-purpose worksheet, a beginning can now be made in the direction of cost control and profitable business management. Care should be taken to use realistic figures for overhead and burden. As a result, a loss should be clearly indicated as such and not hidden by assuming smaller overhead figures or by other means. By "feeding back" information and experience gained from past job performances, estimating and other facets of business management can be improved.

A form will be mailed free to contractors. Send an envelope with name and stamp to Otto W. Walther, P. O. Box 324, Hughson, Calif.



MATERIAL LIST / INVOICE

Chas. J Boggeri — Job No. 814
Rt 1 Box 150 — Hughson — 12-29-59
Install fuse panel, 220 Volt line. surface receptacle for clothes dryer

4'	3/4" EMT	19 27	C	77	10 29	C	41
1	3/4 EMT conn.			39			23
3	3/4 EMT straps	5	E	15	2	E	6
1	9390 Hubbell recept.			2 20			1 93
32'	10-3 romex	196 57	M	6 29	118 90	M	3 78
1	TC 23 311 panel			4 60			3 25
2	½" romex conn.	13	E	26	8	E	16
2	W 30 plug fuses	7	E	14	5	E	10
	Material			15 00			9 92
	Sales Tax			60			
	Labor, etc.			11 00			
	Total			26 60			

LABOR

Werner	12/29 2 ✓	2	5 50	11 00	3 40	6 80

DIRECT JOB EXPENSE

SALES TAX 4 % × 15.00	60
ADDITIONAL PAYROLL COST 10 % OF 6.80	68
PERMIT NO.	
TOTALS	1 28

SUMMARY

COST		BILLING	
MATERIAL	9 92	MATERIAL	15 00
LABOR	6 80	SALES TAX	60
DIRECT JOB EXPENSE	1 28	LABOR	11 00
TOTAL PRIME COST	17 60		
OVERHEAD 25 %	4 38	PERMITS FEES	
BURDEN PER HR		TOTAL BILLING	26 60
TOTAL COST	21 88		
TOTAL BILLING	26 60	INVOICE NUMBER	814
PROFIT (LOSS)	4 72	INVOICE DATE	12-30-59

FIG. 2—Sample of multi-purpose worksheet is arranged to show front, back and centerfold pages. Descriptive data is that of a typical, small, time and material job, used to show the practical use of the worksheet.

Electroluminescence

. . . for High Speed Readability

Highway signs near Sacramento, Calif., utilizing flat self-contained "sandwich" panel-lamps, are being considered for possible use on U. S. 41,000-mile Interstate Highway System. Values associated with these new signs include low power consumption, long life, easy maintenance, comfortable brightness and excellent contrast with background. Construction details and test data are herein compared with other types of present-day sign mediums.

A NEW electroluminescent sign having considerable national significance has just been erected on a high-speed freeway, northeast of Sacramento by the California Division of Highways. Since this huge panel measures 43 ft in width and 8½ ft in height, it has an interesting entity of its own. Yet, as an experimental installation of a new lighting medium used in a new manner, it is being considered for possible use on the 41,000-mile Interstate Highway System.

Since this mammoth high-speed network will consist entirely of freeways and toll roads where directional signs must convey information to motorists quickly and distinctly, it is timely and pertinent to consider the construction, objectives and results of this installation, and to compare such details with data obtained from other sign mediums which are also in use on major highways.

This sign is of "unbalanced butterfly" design, a 30-ft wing overhanging the main highway (to Reno), while a 13-ft section spans a local turnoff. The sign is supported by a galvanized steel pole anchored to a reinforced-concrete buried pedestal. Circuit wiring rises through pedestal and pole to the base of the sign proper where it connects with walkway-mounted ballast boxes, housing current-limiting autotransformers — supplying the sign with 550-volt service from a 120-volt initial power source.

Ballast boxes, cradled beneath a steel-grid maintenance walkway, are accessible by raising a hinged non-slip steel-cover plate set flush with the walkway grating, while wiring between autotransformers and sign is carried through liquid-tight flexible conduit to a wireway located across the top-rear of the sign, thence through separate grommeted leads to connect with the luminescent panels.

In this routing sequence, flexible conduit is attached to steel walkways with copper bonding straps and brass screws. Transformers serving the various panels are rated at 1050-va and are separately protected by 1-amp, slow-blow glass-tube fuses.

Since electroluminescent panels have been undergoing development for over a decade, it is sufficient to mention here that luminosity is obtained from phosphors, sensitive to a fluctuating electric field, which are suspended in ceramic layers applied to thin-steel backing plates and covered by additional layers of transparent, electrically conductive and protective glass films.

In this flat sandwich construction, the steel backing plate furnishes rigidity, and also serves as one conductor in an assembly that may be likened to a capacitor or condenser. The transparent electrically conductive layer constitutes the other plate, and light is emitted when energy passes between these two conductive layers through the electroluminescent phosphor. To insulate and protect this sandwich against humidity and minor mechanical damage, the en-

BALLAST BOX for containment of autotransformers is located beneath walkway grid. Access is from top; a solid non-slip steel-plate cover being provided with handles and hinges for this purpose. Enclosed ballast box contains numerous vent holes, covered with bronze screening, also coupling for conduit feeder. Complete assembly is welded and hot-dipped galvanized after fabrication.

ELECTROLUMINESCENT SIGN has width of 43 ft and height of 100 in. Panel at right contains separately formed, raised, encapsulated and bolted letters; each letter comprising a separate electroluminescent lamp, the leads of which are paralleled to autotransformer secondaries. Panel at left consists of blocks of electroluminescent material with everything except the lettering being painted or blacked-out.

tire assembly is then sealed by a final glass coating.

Although electroluminescent panels were relatively small when first developed, they now are available in sizes up to 27 by 30 in. making it possible to either (1) form individual letters in dimensions ranging up to these sizes, with luminous letters then constituting the lamps themselves, or to (2) completely cover a large surface with electroluminescent sheets placed adjacently, then to paint out areas surrounding the letters, thereby accomplishing the same message by a different means.

In the sign herein discussed, both of these methods are involved, inasmuch as lettering on the smaller wing is formed with individual letters, separately encapsulated in clear plastic for weatherproofing, while the larger wing involves the background-blackout technique.

In the first of these two methods, letters are mounted to the backing panel by bolts piercing peripheral flanges. This method holds letters securely in place while offsetting them slightly from the background to produce a daytime 3-dimensional effect when normal shadows emphasize letter segments. And, to further improve daytime contrast, letters are edged with white opaque borders.

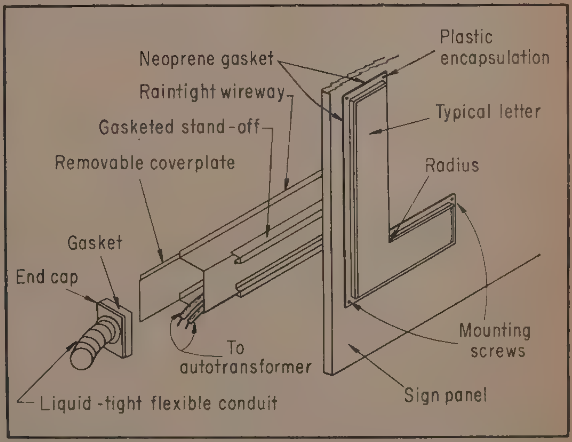
While such lettering has excellent visibility and fast readability, it also has several disadvantages, such as a greater cost related to forming the individual letters, mounting them separately to the backing panel and sealing letter edges positively to preclude penetration of moisture.

These costs and problems are eliminated with the background-blackout method. Although when larger basic panels are used, it is obvious that current consumption is greater. In either instance, however, power consumption is relatively small, being in the order of only 6 watts per sq ft with an average current density of 30 ma per sq ft.

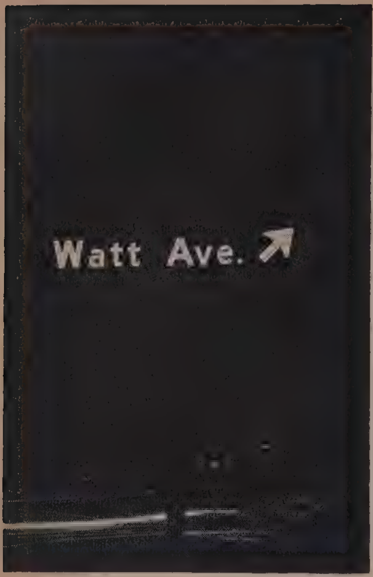
By combining the two methods into a single sign, it will be possible to directly relate various initial and operating charges and to plot the break-even point where amortization and operating curves intersect.

Average brightness of panels is 2.8 footlamberts. Letters appear as light green when energized, white otherwise. With both methods, leads from formed letters or rectangular panels are carried through rubber grommets located at upper-rear of encapsulations, then are spliced in parallel to auto transformer secondary leads located inside the common wireway. With operating current at 550 volts and 60 cycles, lamp life for this sign is estimated at about 10,000 hours.

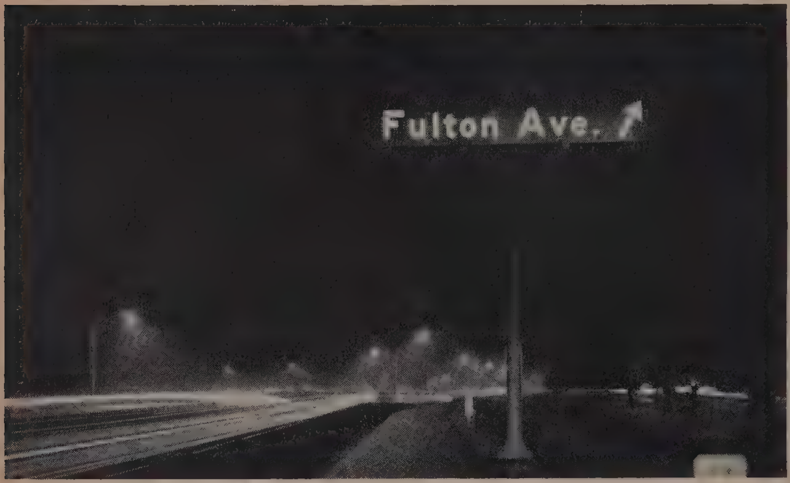
WIRING CONNECTIONS between autotransformers and individual electroluminescent letters of highway sign are established via flexible liquid-tight conduit and boxes secured to the rear of each panel. Since entire framework of sign is enclosed after erection, connections of completed installation are concealed.



ASSEMBLY DETAILS show method of sealing and mounting separate letters to backing panel, also construction of wireway containing sign leads that connect with autotransformer power source. By offsetting letters from backing panel and edging them with white opaque borders, daytime contrast and resulting readability are improved.



FIRST HIGHWAY SIGN in the U. S. to utilize electroluminescent panels was erected near Sacramento in Fall of '58. Since size of individual panels was relatively small, capital letters and arrow required more than single luminous lamp for their formation, thereby complicating problem of positive weatherproofing. Power consumption for this installation was only 108 watts; approximately 40% of that required by fluorescent lighted sign having comparable letter brightness and uniformity. Note how background of electroluminescent sign has disappeared from view entirely, due to absence of any direct illumination in front of panel. Also note presence of small reflectorized sign at lower right which has brightness value of 25 candlepower per sq ft when directly illuminated by headlights of approaching traffic.



SIGN USING ULTRAVIOLET or "black" lighting strips placed in front of lower edge of panel was an improvement over direct-lighted fluorescent units, inasmuch as reflection from fluorescing letters was greater than from unsensitized background and contrast ratio was correspondingly increased. However, although de-emphasized, the background was still evident, while power consumption was considerably greater, two factors that lessened its acceptability.

Size, location, brightness and construction of this electroluminescent sign is the result of a two-year study involving previous installations, located along New Jersey's Garden State Parkway and at Miami's International Airport, as well as in the Sacramento area, where the first (Watt Ave.) sign was erected in September 1958.

During this interval, sizes of panels have progressively increased. Efficiencies and brightness values have been improved by raising line voltages and frequencies. Phosphors, producing colors other than green (such as red, blue and yellow), have been utilized successfully. And advancements also have been achieved with lamp construction and weatherproofing techniques.

Since lamps and letters are one and the same thing, no intermediate diffusing element is involved. This means that total lamp output is effectively utilized, resulting in brighter letters with less power consumption.

Since backgrounds of electroluminescent signs receive no direct illumination, their brightness value is zero. This means that the contrast is infinite between luminous letters and totally black surrounding surfaces. With infinite contrast, visibility and readability are maximum.

Since no external fixtures are involved, maintenance is lessened. And with no lamp filaments to fail, no internal gases to contaminate and no emissive material to be consumed, lamp life is excellent (except in those cases where lamps are subjected to conditions beyond their designed potential, such as excessive voltage).

These several advantages highly recommend this new light source for highway sign applications. And, since signs have adequate and uniform brightness, freedom from glare, maximum contrast with backgrounds, soft diffusion, no danger of suddenly burning out or decreasing in brightness under normal temperature fluctuations, these directional mediums are receiving critical attention from highway and safety engineers alike.

The importance of sign legibility cannot be overstressed because, as multiple-lane highway construction increases and high-speed high-density traffic becomes correspondingly greater, the momentary indecision of a motorist could easily cause confusion having severe consequences. For that reason, signs must be plainly legible during hours of daylight and darkness alike. They must also attract attention and have fast readability in order to impart directional information quickly. And, since signs located low-down on shoulders of multiple-lane highways can be obscured from the view of motorists in center lanes by cars in outer lanes, such signs must be elevated.

These electroluminescent findings augment an impressive mass of practical sign data collated by California's Highway Division, because their research program has included study of numerous mercury-vapor, incandescent, fluorescent, ultra violet and reflectorized sign treatments as well.

For example, in studying front-lighted opaque signs, it was learned that adequate brightness was essential in order to obtain adequate contrast between letters and background, although excessive brightness could result in glare which in turn would lessen readability. It likewise was discovered that although some front-lighting fluorescent fixtures, especially designed for highway sign use, could deliver initial intensities of 30 fc or more to sign areas, and that initial contrast ratios between sign backgrounds and lettering would be in the order of 20 to 1, these intensities and contrasts could diminish rapidly as road dirt and oil film accumulated on signs and fixtures. Coincidentally, white letters and black backgrounds would deteriorate into varying shades of gray, while oil film would accentuate glare. In this connection, a letter-background contrast ratio of 10 to 1 was considered the minimum acceptable limit.

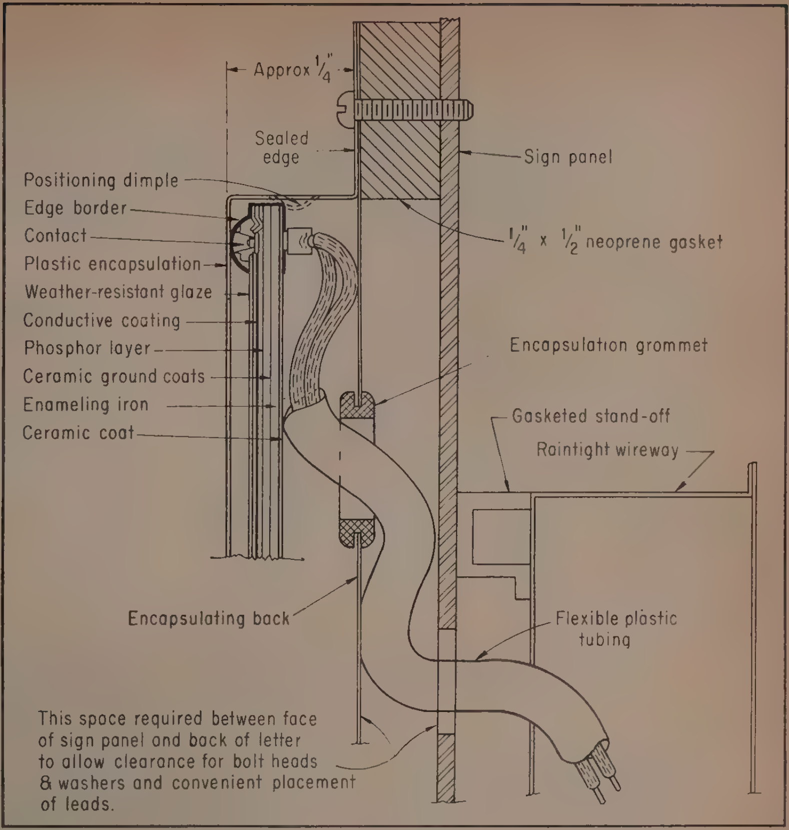
It was also determined that signs should be illuminated over their entire message areas within a uniformity ratio of 4 to 1, a practical impossibility when illumination sources are placed in front of (either above or below) opaque sign panels. For example, a 10-ft-high commercial signboard with fluorescent fixtures placed 4 ft in front of the bottom edge can easily have a brightness variation of 12 to 1 from bottom to top.

Another factor considered relative brightness of opaque signs and surrounding backgrounds. Tests indicated that signs in brightly lighted urban areas required greater overall illumination than did signs in dark rural districts.

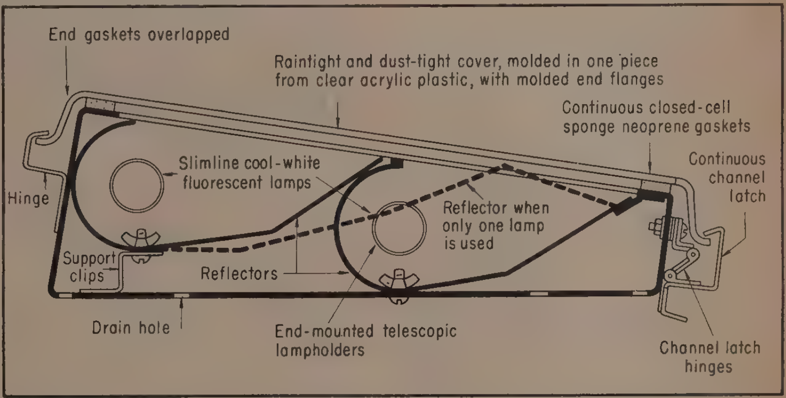
As to placement of lamps for elevated sign illumination, it was evident that fixtures be located below rather than above panels, since light from overhead sources would be reflected into eyes of oncoming motorists and, if signs were located above 2-way traffic, spill-light would result in direct glare. Fixtures above the panel also result in a shadow across the sign message during the daytime.

To lessen reflection from sign backgrounds and thereby increase letter-background contrast ratios, experimentation included the use of ultraviolet (or "black") light, with fluorescent material placed only on the lettering. When illuminated, white letters appeared greenish-white and black backgrounds disappeared entirely. This restored desirable contrast, although considerably more power was required, and letter brightness was somewhat less than when signs were lighted by fluorescent lamps.

It is obvious that laboratory tests and field tests are not necessarily equivalent, since results can be affected by voltage variations, atmospheric conditions, dirt accumulations and the like. However, in performing their research tests, the California Highway Division attempted to be as practically realistic as possible. In this connection, signs were set up in suitable dark rooms. Panels were covered with matte finishes having readings between 68 and 73 glossmeter units. Fluorescent lamps were aged at least a hundred hours before testing. Adequate voltage control was provided. Fixtures were located in front of panels at the same distances and relative positions that would prevail in actual installations. Illumination over the sign was measured by a cosine-corrected sensitive light meter, and brightness readings of letters and backgrounds were made with a half-degree brightness spot meter.



CROSS SECTION through electroluminescent panel and raintight wireway indicates contour of plastic encapsulation, gasket details and routing of leads in flexible plastic tubing between panel contacts and autotransformer secondaries. As indicated, layer of electroluminescent phosphor is covered by conductive coating and weather resistant glaze, backed by thin metal plate and ceramic coatings.


End gaskets overlapped
Raintight and dust-tight cover, molded in one piece from clear acrylic plastic, with molded end flanges
Continuous closed-cell sponge neoprene gaskets
Continuous channel latch
Hinge
Slimline cool-white fluorescent lamps
Reflector when only one lamp is used
Support clips
Reflectors
Drain hole
End-mounted telescopic lampholders
Channel latch hinges

MOLDED PLASTIC COVER of fluorescent sign fixture for direct lighting is gasketed with sponge neoprene and secured to metal casing by continuous hinges and latches to exclude dirt and moisture. Cool-white slimline lamps are completely shielded from motorists' angle of vision by contour of Alzak aluminum reflectors. Ballasts, individually protected by slow-blow glass-tube fuses, are rated for 300-ma operation.

• *ESTIMATING FORUM—V*

Financing the Job

By Ray Ashley, *Research and Consulting Engineer, Oak Park, Ill.*

STATEMENT:

The S & A Electric Company secured a $50,000 contract whose estimated base costs and markups are shown in Fig. 1.

The project was to start January 2nd and the partners estimated that it would take ten months to complete the job. Contract terms called for S & A's bills to be rendered the first of each month and paid by the 10th of the same month. Until the job was completed and accepted 20% was to be withheld.

Estimated base cost per month (Fig. 2) would be $4,500 with an average monthly draw of $4,000 (the $5,000 billing less 20%). On this basis, the partners earmarked $5,000 to finance the job. Their reasoning was that the $500 monthly difference between base cost and draw would be all that would be required and the $5,000 would carry them through the 10-month job duration.

The partners did not expect to need any bank help until October. Actually, this job made them go to the bank in July.

QUESTION: ***What was wrong with S & A's financing plan?***

ANSWER: ***They neglected to take into account the fact that each month there would be an outlay of over $2,900 before their payment request was honored. Although the contract called for payment by the 10th of the month, routine checking procedures might cause delays in monthly payments.***

DISCUSSION:

A closer look at the balance sheet for this project at the end of six months' duration will give a clearer picture of S & A's position. Fig. 3 shows a statement of conditions on July 6th after the material bills for June had been paid. This does not include any allowance for the July payroll or for the July operating expense.

Of the $5,000 originally earmarked for this job, only $2,000 was left. The July payroll and operating expenses alone would require some $2,900. Material costs would be added to that. The only recourse was for S & A to call on their bank for help much sooner than they had expected.

We all know that at times arrangements can be made to temporarily put off paying some bills. We also know that job and office payrolls must be met promptly. And if bills are to be discounted, they must be paid on time. Remember, the contractor who consistently meets his obligations and pays his bills has the buying power required for successful operation.

FIG. 1—BASE COSTS AND MARKUPS FOR THE $50,000 CONTRACT

Materials	$16,000
Labor (payroll, including supervision)	16,000
Direct jobs costs—Insurance, tools, cartage, etc.	4,000
Operating overhead	9,000
Return (anticipated profit)	5,000
Total	**$50,000**

FIG. 2—ESTIMATED COSTS PER MONTH

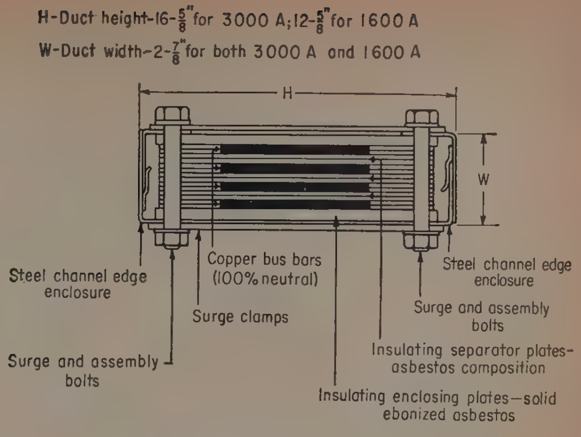
Labor (job payroll)	$1,600	
Direct job expenses	400	
Operating overhead	900	
Total labor and operating expense		$2,900
Materials		1,600
Total Cost per Month		**$4,500**

FIG. 3—STATEMENT OF CONDITIONS AFTER JULY 6
(June material bills had been paid)

Payroll and operating costs to June 1st (6x$2,900)	$17,400
Material bills paid (6x$1,600)	9,600
Total expenses	$27,000
Payments received (6x$4,000)	$24,000
Amount of cash reserve used ($27,000—$24,000)	$ 3,000
Remaining cash reserve ($5,000—$3,000)	$ 2,000

Bus Risers Solve Hotel Rewiring Problem

Shallow bus duct feeders break congested electric closet bottleneck at Milwaukee's Hotel Schroeder; permit smooth changeover to ac for air conditioning loads.


H-Duct height-16-5/8" for 3000 A; 12-5/8" for 1600 A
W-Duct width-2-7/8" for both 3000 A and 1600 A
H
W
Steel channel edge enclosure
Copper bus bars (100% neutral)
Steel channel edge enclosure
Surge clamps
Surge and assembly bolts
Surge and assembly bolts
Insulating separator plates-asbestos composition
Insulating enclosing plates—solid ebonized asbestos
Sandwich-Type Shallow Feeder Bus Duct

CROSS-SECTION of 3-phase, 4-wire feeder bus duct showing shallow sandwich design and dimensional features that resolved the space problem.

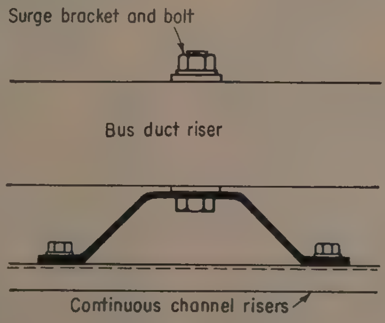
By August Eckel

ADDITION of air conditioning to guest rooms at Milwaukee's 850-room, 25-floor Hotel Schroeder required a major rehabilitation of the hotel's electrical distribution system, including conversion of all room power from direct to alternating current. To the Herman Andrae Electrical Company, project electrical contractor, this job presented a challenging test of field engineering and installation ingenuity. Among the electrical problems encountered were these common to high-rise building rewiring: finding space for the new distribution feeders; maximum use of existing facilities; minimum inconvenience to hotel operation and guest comfort.

Close cooperation between management, electrical contractor and equipment suppliers resolved the major problems and permitted an orderly conversion with minimum difficulty. In fact, Andrae engineers' broad knowledge of electrical equipment and installation techniques contributed substantially to the ease with which a seemingly impossible installation was made. Evidence that equipment selection and field engineering were key factors in this specific project is apparent in the accompanying installation photographs.

AC Distribution

The 3-phase, 4-wire (100% neutral), 208/120-volt distribution originates at an alternating current board in the basement installed several years ago to serve elevators and other hotel equipment. At that time, management insisted that spare capacity be included for future use. A new breaker in this board serves a 3,000-amp, 4-wire, low-impedance copper bus duct which goes up to a new sub-distribution board on the sixth floor. At this point, two 1,600-amp, 4-wire bus duct risers fan out to north and south electrical closets and extend up to the 19th floor. For the last six floors, risers consist of cable in conduit because no electrical closets exist.



TYPICAL METHOD of supporting vertical duct risers in electric closets. Special brackets attach duct to continuous channel "rails" going up through closets.

Circuit-breaker tap-offs at each floor serve new ac branch-circuit panels, installed in existing cabinets with new trims. Breaker enclosures for the first five floors (3,000-amp bus) have one breaker and space for a spare. Other enclosures are the single type. All breakers are 225-amp frame size with a 200-amp trip.

All rooms were completely rewired with new conductors in existing conduits and an extension installed to a new outlet for either a portable or built-in air conditioner. Each room now has one 208-volt circuit for air conditioning and one 120-volt lighting circuit. Panel breakers on each floor are numbered to identify the rooms they serve. Thus, two-pole breaker No. 5 controls the 208-volt air-conditioner circuit in Room 5. Single-pole breaker No. 5 controls 120-volt lighting circuit in same room.

Use Shallow Bus Duct

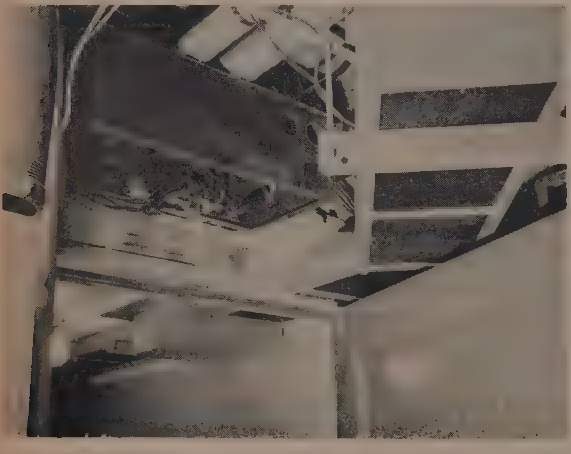
Finding space for the new bus duct risers was the biggest installation problem, according to Erv March, Andrae superintendent. The logical, and as it turned out, only

CORRIDOR RUN of 3,000-amp bus duct in basement ends 175 ft from existing switchboard in double offset which turns up into first-floor electric closet. Note sturdy duct supports.

REMOVAL OF three 2,000 MCM dc cables cleared path for 3,000-amp bus duct riser under first-floor electric closet.

OFFSET IN ac feeder in third-floor electric closet carries 3,000-amp bus duct to right for clear path up to next floor.

CROWDED CONDITIONS at top of third-floor closet typify space problems contractor encountered. 3,000-amp feeder duct riser is hidden by conduit concentration and cable splice box at right.



SOUTH FEEDER duct (1,600-amp) leaves sixth-floor distribution board, angles over door frame to hotel corridor on way to south tier of electric closets serving next 20 floors.

TOP SECTION of exposed duct-connection enclosure is recessed in corridor ceiling opening. Removable cover plates (arrow) provide required access to bolted bus bars.

DUCT RISER goes up through first-floor closet; is supported by special brackets (arrow) on continuous channel "rails."

CABLE SUPPORT BOX for dc cables near top of first-floor closet was cut away so ac feeder duct (arrow) could continue to next floor.

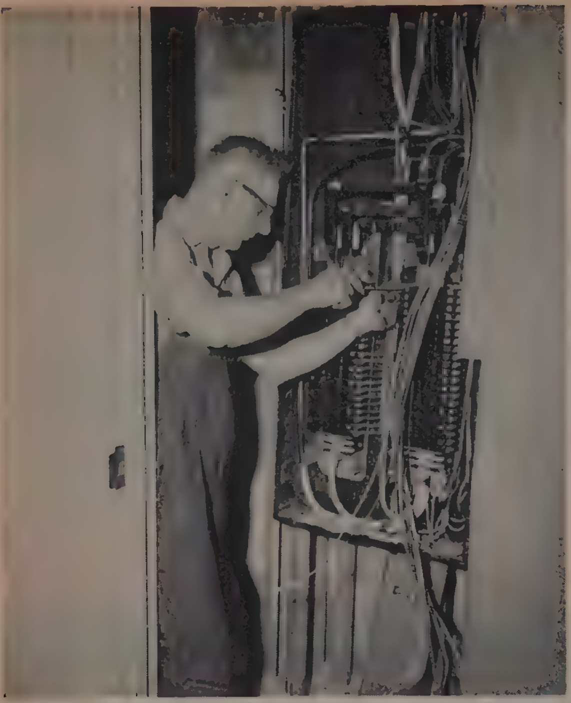
DUCT HUGS CEILING in corridor crossover, and 3,000-amp section with elbow and joint box was tipped in wall opening (dotted outline), turned 180°, and probed back into closet.

NEW DISTRIBUTION BOARD on sixth floor splits 3,000-amp feeder into two 1,600-amp riser ducts for rest of floors; serves fifth floor circuits through wiring trough in center.

TYPICAL INSTALLATION of 1,600-amp bus duct risers in upper-floor electric closets.

available, place was the existing electrical closets which provided ready access between floors. But these already were overcrowded. Even with the removal of some existing dc feeders, space would be tight and clearances highly critical. And getting from the switchboards to the closets meant exposed corridor runs in many cases. The solution lay in selecting a duct with the smallest physical dimensions possible for the capacity involved and tailoring the installation to existing field conditions.

Once equipment selection was made, field engineering continued and the tailoring process began. The duct manufacturer's representative spent several days on the job site going over the new distribution layout; taking accurate dimensions of every foot of duct run; detailing offsets, crossovers, closet takeoffs; and planning duct fabrication to meet March's work schedule. Generally, this called for installation of horizontal runs from distribution boards to electric closets first. Then, working from the floor above, risers were extended up through the closets. Duct sections were fabricated so they could be handled easily on the job, dropped into position from the floor above, and assembled at easily accessible joint connections. Dimensional isometric drawings developed from this field data served as working drawings for the duct fabricators and as installation drawings for the Andrae mechanics.



NEW CB PANELS, mounted in existing cabinets, serve rewired hotel rooms with one 208-volt air conditioning circuit and one 120-volt lighting circuit per room.

AC BUS RISERS end at 19th-floor electric closets. 400-amp breaker at top of bus duct serves cable and conduit feeders to next six floors.

RACEWAY EXTENSION carries 208-volt circuit to window outlet for portable or permanent air conditioning unit in each room.

OLD AND NEW distribution facilities in same electric closet; dc switches and fuses at left, ac breakers and bus riser at right.

Continuous channel was used extensively as a duct supporting medium, both as horizontal trapeze hangers and wall brackets, and vertical riser "rails" in the closets. Special flat-iron offset brackets were used on the risers. Each was fastened to the bus casing at a surge-bolt point and mounted to the channel with two sturdy bolts. In many cases, brackets were made deep enough to support the duct in front of existing conduits or pipes.

The project was completed with minimum interruption of hotel activity and inconvenience to guests. To provide room in the electric closets for the ac feeder ducts, three 2,000 MCM dc cables (each in a 3-in. conduit) were removed. Any affected loads were temporarily transferred to existing circuits. The 3,000-amp duct riser followed the back wall of the electric closets, in the center or to one side wherever a path could be cleared. The north and south risers above the sixth floor followed a side wall of the smaller electric closets. As the new feeders went in, old distribution equipment was removed from existing enclosures and new ac breaker panels were installed.

VOLTAGE CHANGES in induction motors may be accomplished in either of two ways: (1) by reconnecting coil end connections or (2) by complete rewinding—stripping the stator completely, inserting new slot cell liners and new coils. Adequate dipping and baking (right) provide the finish to either job.

Reconnecting and rewinding for ......

Voltage Change in Motors

Here's clear, step-by-step instructions in adapting induction motors for change in voltage rating, covering reconnection of windings and complete rewinding.

By John Molnar, P. E., *Consulting Engineer, Moorestown, N. J.*

MANY interesting and diverse problems are encountered in motor rewind shops besides replacing faulty windings turn-for-turn and wire size-for-size. The area that offers the most stimulating challenge to the winder is where he is able to adapt a motor to a new set of conditions. These include speed changes, frequency changes, horsepower changes and voltage changes. Reconnecting or rewinding induction motors to accommodate a voltage change is more often considered and accomplished than any other change.

There are numerous reasons why motor voltages must be changed. This need may arise from the purchase of a used motor, a change in supply voltage from an isolated plant to central-station power, the remodeling of an old distribution system or to satisfy ambient conditions. Remodeling an old distribution system is usually done to accommodate increased load. In this case the system voltage is increased, therefore a motor voltage change is necessary. Quite frequently, ambient conditions dictate the need for reduced motor voltage to decrease the frequency of motor burn-outs. It is an established fact that motors operating on 110 volts result in less frequent motor burn-out due to insulation failure than motors operating on 440 volts. This is due to reduced dielectric stress at the lower voltage.

There are two methods that can be utilized by the winder to accomplish a motor voltage change:

1. He may make winding connection changes on the pole-phase-group level.
2. He may strip the motor and completely rewind it.

Voltage Changes by Reconnection

As changing the winding connections is usually more economical and can be done much faster, it will be studied first. Changing voltage on a dual-voltage motor to the other voltage does not constitute a connection change, and therefore these will not be discussed here.

Motors are designed originally to operate at a certain voltage across each coil or groups of coils. These coils or groups may be in series or in various parallels to accommodate different line voltages. As long as the voltage across each coil remains at the value originally calculated, the operation of the motor will be normal in all respects. In other words, this means that the volts-per-turn has not been changed.

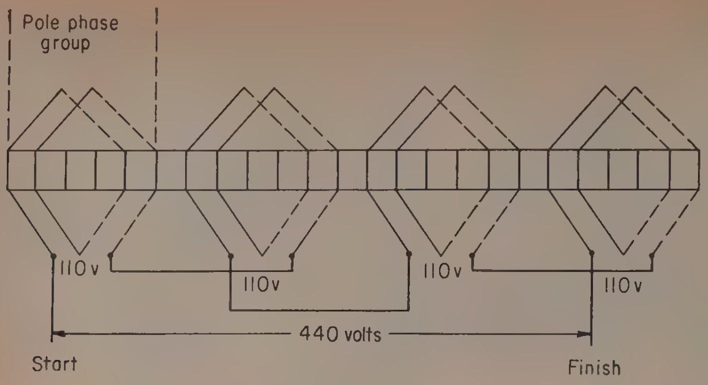


Fig. 1

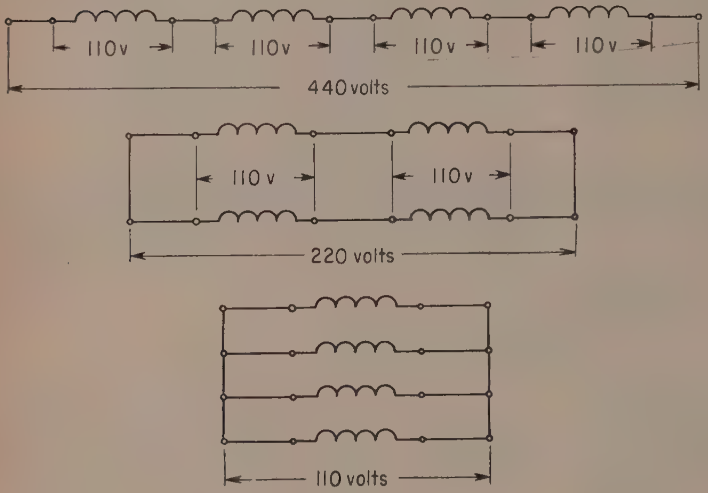


Fig. 2

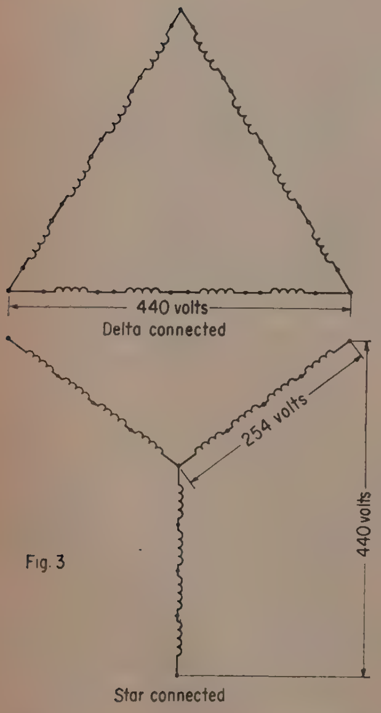


Fig. 3

At this point, it is well to review some basic fundamentals. As an example, a 440-volt, 3-phase, 4-pole, 24-slot, fractional pitch 1-5 delta-connected motor will be discussed. Fig. 1 shows the stator rolled flat and one phase winding in place. This being delta connected, the phase voltage is equal to the line voltage. It contains two coils per pole-phase-group and some certain amount of turns per coil. These coils are connected in series so that the motor can operate on 440 volts.

Fig. 2 is a winding schematic that shows the various possible series, series-parallel or parallel connections necessary to accommodate 440, 220 or 110 volts.

In Fig. 3, all three phases are included and the voltage relationship between the star and delta connection is shown. The phase voltage on a star-connected motor is equal to the line voltage divided by $\sqrt{3}$, i.e., $254 = 440/\sqrt{3}$. On delta-connected motors, the phase voltage is equal to the line voltage.

Calculating Voltage Possibilities

Reconnecting motors at the pole-phase-group level can yield new voltages that vary from 10% to 1000% of the original. These are calculated in the following manner:

Series Star = 100%: To find any parallel star divide 100% by the number of parallel circuits, i.e., a 4-parallel star = $\frac{100\%}{4} = 25\%$. For simplification, it is possible to use the voltages directly; therefore, $\frac{440}{4} = 110$ means that a 440-volt series star may be connected 4-parallel star and operated on 110 volts. As this happens to be a standard voltage no further consideration need be given. It is only necessary to make the connection and put the motor into use.

Series Star = 100%: To find any series delta divide 100% by $\sqrt{3}$ (1.732), i.e., $100\%/\sqrt{3} = 58.8\%$. To change a series star into any parallel delta divide the 100% by $\sqrt{3}$ and the number of parallel deltas required, i.e., a 3-parallel delta connection = $\frac{100\%}{\sqrt{3}\text{x}3} = 19.2\%$. This has been done for 12 different connections and is shown in Table I. The figures in the table are shown as percentages of the original voltage.

As an example, a 6-pole, series-star, 2200-volt motor is to be connected for 440 volts. Since 440 is 20% of 2200, the problem resolves itself into how a series-star connection may be changed so that the resulting voltage will be 20% of the original value. Find 100% opposite series star, read across the horizontal line until 20% is found and above this read 5-parallel star.

It was agreed earlier that all connection changes will be made on a pole-phase-group level. This means that the number of poles must be evenly divisible by the parallel circuits. Obviously $6 \div 5$ does not yield a whole number, therefore the connection is not possible. A further search across the table yields the number 19 under the vertical heading 3-parallel delta. This connection is possible. This, of course, will give a voltage less than 440 volts, in fact it will be 95% of 440 or 418 volts. The effect produced by this lower voltage must be studied carefully.

Considerations Before Reconnection

Serious consideration should be given to any connection change before it is actually accomplished. There are two areas where caution should be exercised:

1. changes to higher voltages and
2. changes to a non-standard voltage.

Whenever motors are considered for reconnection to yield a higher voltage motor, the insulation is the limiting factor. If there is any doubt of the adequacy of the winding insulation, an insulation test should be conducted. Usually, motors wound for 110 or 220 volts may be reconnected for use on 440 or 550 volts. But motors wound for 550 volts or less should not be operated on 2200 volts even if the number of turns in the coils be properly operated. However, there is no reason why motors built for a higher voltage should not be operated on a lower one.

Where the reconnected motor voltage is not equal to the available system voltage, further study is necessary. First of all, undesirable motor characteristics may result. However, if this variation does not exceed ±10% of the motor voltage it may be operated on that voltage. But in any case where the variation exceeds ±5%, caution must be exercised. Load-current readings should be taken and the motor temperature should be checked. These conditions will determine the possibility of a successful operation.

As an example, observe what happens if a 440-volt series star is connected to series delta and operated on 220 volts. The motor voltage is actually $440/\sqrt{3} = 254$ volts. This means that the motor is operating at 220/254 of motor rated voltage, or at 87%. Many motors may have sufficient margin to stand this reduction but there will be certain changes in operating characteristics. Table II shows the general effect of voltage variation on induction motors and also how the characteristics vary.

In the above case:

1. copper heating up 33%
2. starting torque down 25%
3. maximum torque down 25%
4. slight increase in power factor
5. slight decrease in efficiency.

From this it is obvious that in certain cases reconnecting does not yield satisfactory results.

TABLE I—Three-phase Motor Voltage Connections

TYPE OF RECONNECTION ➡ ORIGINAL CONNECTION ⬇	Series Star	2 Parallel Star	3 Parallel Star	4 Parallel Star	5 Parallel Star	6 Parallel Star	Series Delta	2 Parallel Delta	3 Parallel Delta	4 Parallel Delta	5 Parallel Delta	6 Parallel Delta
Series star	100	50	33	25	20	17	58	29	19	15	12	10
2 parallel star	200	100	67	50	40	33	116	58	39	29	23	19
3 parallel star	300	150	100	75	60	50	173	87	58	43	35	29
4 parallel star	400	200	133	100	80	67	232	116	77	58	46	39
5 parallel star	500	250	167	125	100	83	289	144	96	72	58	48
6 parallel star	600	300	200	150	120	100	346	173	115	87	69	58
Series delta	173	86	58	43	35	29	100	50	33	25	20	17
2 parallel delta	346	173	115	87	69	58	200	100	67	50	40	33
3 parallel delta	519	259	173	130	104	87	300	150	100	75	60	50
4 parallel delta	692	346	231	173	138	115	400	200	133	100	80	67
5 parallel delta	865	433	288	216	173	144	500	250	167	125	100	83
6 parallel delta	1038	519	346	260	208	173	600	300	200	130	120	100

To use this table: Identify the original connection in the vertical column of headings at left. Move horizontally across the table from this heading to the vertical column headed by the type of reconnection to be made. The figure given at this intersection indicates the voltage of the reconnected motor as a percentage of the voltage of the original connection.

Example: A series star motor is to be changed to five parallel star. The voltage of the reconnected motor will be equal to 20% of the voltage of the motor with its original connection.

Or this table can be used to determine the type of reconnection needed to obtain a required percentage of the original voltage. Say a four-parallel star motor is to be rewound for twice its present voltage. From the table, it can be seen that two-parallel star will produce a voltage rating equal to 200% of the original.

TABLE II—Effect of Voltage Variation on Induction-Motor

	90%	Variation	110%	120%
Torque Starting & Maximum	−19%	Varies as E^2	+21%	+44%
Speed	——	Constant	——	——
Slip	+23%	Varies as $\frac{1}{E^2}$	−17%	−30%
Full Load Speed	−1.5%	——	+1%	+1.5%
Starting Current	−11%	Varies as E	+11%	+25%
Full Load Current	+11%	——	−7%	−11%
Temperature Rise at Full Load	+5 to 7°C	——	−3 to 4°C	−5 to 7°C
Full Load PF	+1 point	——	−3 points	−10 points
Full Load Efficiency	−2 points	——	+1 point	+slight

Rewinding for Different Voltages

There are several reasons why motors are rewound for different changes:

1. Reconnecting will not yield a voltage suitable for use on an available system.
2. Voltage increase is necessary and this is beyond the safe rating of the insulation.
3. Burned out motors are available for rewind.

This can be solved by designing a new winding for the motor, but usually all this work is unnecessary. The author has devised a scheme whereby about 95% of all voltage-rewind cases can be solved simply and rapidly.

General Rule: The number of effective conductors should be increased or decreased in direct ratio as the increase or decrease in applied voltage. The number of effective conductors is the actual number of conductors that would be required in a full-pitch polyphase winding having one slot per pole per phase to give the same magnetic field and torque as obtained with the actual chorded winding of more than one slot per pole per phase.

Effective Conductors/phase = actual series conductors times the chord factor times the distribution factor.

From this it is obvious that when the chord factor and distribution factor equal unity (1) then the effective conductors equal actual conductors.

Distribution factor (f_d) = vector sum of voltages of the coils in a group ÷ arithmetic sum of voltages of the coils in a group

TABLE III — Distribution factors for three-phase windings

slots per pole per phase	f_d
1	1.000
2	0.966
3	0.960
4	0.958
5	0.957
6	0.956
infinity	0.955

TABLE IV—Chord Factors For Polyphase Motors

	Slots Per Pole												
Throw	24	18	16	15	14	13	12	11	10	9	8	7	6
1–25	1.000	0.866											
1–24	0.998	0.906											
1–23	0.991	0.940	0.831										
1–22	0.981	0.966	0.882										
1–21	0.966	0.985	0.924	0.866									
1–20	0.947	0.996	0.956	0.914	0.847								
1–19	0.924	1.000	0.981	0.951	0.901	0.833							
1–18	0.897	0.996	0.995	0.978	0.944	0.884	0.793						
1–17	0.866	0.985	1.000	0.995	0.975	0.935	0.866	0.756					
1–16	0.832	0.966	0.995	1.000	0.994	0.971	0.924	0.841	0.707				
1–15	0.793	0.940	0.981	0.995	1.000	0.993	0.966	0.910	0.809				
1–14	0.752	0.906	0.956	0.978	0.994	1.000	0.991	0.960	0.891	0.766			
1–13	0.707	0.866	0.924	0.951	0.975	0.993	1.000	0.990	0.951	0.866	0.707		
1–12	0.659	0.819	0.882	0.914	0.944	0.971	0.991	1.000	0.988	0.940	0.831		
1–11	0.609	0.766	0.831	0.866	0.901	0.935	0.966	0.990	1.000	0.985	0.924	0.782	
1–10		0.707	0.773	0.809	0.847	0.884	0.924	0.960	0.988	1.000	0.981	0.901	
1–9		0.643	0.707	0.743	0.782	0.833	0.866	0.910	0.951	0.985	1.000	0.975	0.866
1–8			0.698	0.669	0.707	0.749	0.793	0.841	0.891	0.940	0.981	1.000	0.966
1–7			0.570	0.616	0.624	0.663	0.707	0.756	0.809	0.866	0.924	0.975	1.000
1–6				0.530	0.532	0.566	0.609	0.655	0.707	0.766	0.831	0.901	0.966
1–5									0.508	0.643	0.707	0.782	0.866
1–4											0.570	0.624	0 751

The recommended procedure does not require a change in the number of slots per pole per phase. Therefore, there will be no change in the distribution factor (Table III).

Chord factor (f_c) = actual voltage generated in the coil/voltage of a full pitch coil = sin ½ (coil span in electrical degrees)

With no change in (f_d), the formula for effective conductors per phase = actual series conductors x f_c. From this, it is readily seen that with no change in the actual series conductors, the effective conduction varies directly as the chord factor. Therefore the general rule can be restated, within wide limits, "the chord factor should be increased or decreased in direct ratio to the applied circuit voltage."

The author's recommended procedure for rewinding is as follows:

1. Select from Table I the connection that yields a voltage closest to the supply voltage (keeping in mind that the number of poles must be divisible by the number of parallel circuits).
2. Calculate the percent devia-

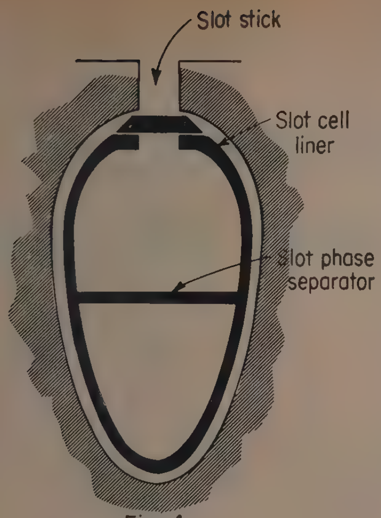


Fig. 4

tion from the applied circuit voltage.

That is, determine the percentage value by which the motor voltage rating from Table I (for the type of reconnection) deviates from the voltage rating of the circuit on which the motor is to be applied. It should be remembered that we are here using the Table on reconnection only as one step in the procedure for rewinding the motor.

3. Enter Table IV and read down under the correct slots per pole until it intersects the existing throw. Read up or down in the chord factor column until a suitable f_c is obtained. From that, find the new throw. A coil should in no case be chorded more than half of the pole pitch. All the correction that is necessary is to reduce the voltage deviation within ± 10% in most cases. Many factors dictate the actual percentage allowable. Experience will be the guide.

One final word of caution: When motors are rewound for much higher voltages, the motor slot area becomes the limiting factor (Fig. 4). Insulation occupies space, and there may not be sufficient space to accommodate the necessary added insulation. The physical possibility of fitting conductors into the given space must always be carefully determined before attempting rewind for higher voltage.

Rewind Data Accumulation

Certain information must be gathered before any motor is stripped for rewind. This applies whether the motor is to receive an identical winding or is being rewound for one of the numerous winding changes. The rewind data card shown in Fig. 5 is typical, but there are many variations. Most rewind equipment manufacturers have similar cards that can be purchased for use in the shop.

The idea behind using data cards is to accumulate data on the wiring and construction of any given motor before an attempt is made to modify the characteristics of the motor. And development of a substantial file of data on original windings and redesigned windings for specific makes and sizes of motors can greatly increase the speed of future work on similar motors.

The author did not intend to infer that he has exhausted all possibilities in the area of voltage changes for induction motors.

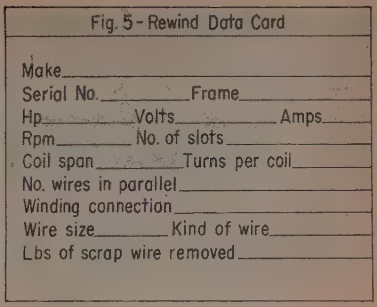


Fig. 5 - Rewind Data Card

Make________
Serial No.________ Frame________
Hp________ Volts________ Amps________
Rpm________ No. of slots________
Coil span________ Turns per coil________
No. wires in parallel________
Winding connection________
Wire size________ Kind of wire________
Lbs of scrap wire removed________

Another system changes the turn per coil to accommodate the change in voltage. And still another changes both the turns per coil and also the coil span. The primary intent of this discussion was to stimulate interest on the part of the motor winder in an area that is usually considered complex. Further, this should serve as a guide for motor voltage changes.

FINAL STEP in voltage change operation—whether reconnected or rewound—is spray painting of the housing.

ELECTRIC HEATING FORUM No. 4

Effect of Glass Area And Framing on Wall Heat Loss

By W. J. Novak

Analysis of heat loss through wall framing and glass areas reveals short-cut method of calculating heat loss through heavily insulated walls.

CALCULATION of the U-factor between studs of all common 2 by 4 frame wall constructions having the stud space filled with mineral wool insulation or its approximate equivalent will give a factor (rounded off to two decimal places) of 0.07 Btuh[1] per sq ft per deg F temp diff (see Fig. 1). This is the thermal performance value recommended as a maximum for frame walls in the new All-Weather Comfort Standard.[2]

The Electric Heating Forum is designed to provide a means of industry-wide communication on electric heating practices and problems.

This month the effect of window area and wood framing on heat loss is investigated. The added importance of such areas in heavily insulated structures should be thoroughly understood by the electric heat installer and designer for proper development of annual energy estimates and to insure that accurate and intelligent recommendations can be made when his advice is requested.

Readers are invited to express their opinions; relate their own experience data to the material presented; or submit new ideas, research data, or case studies on any aspect of electric heating. Please address correspondence to:

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Electrical Construction and Maintenance
330 W. 42nd Street
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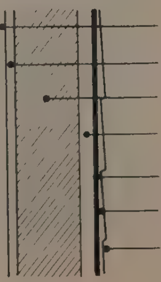
A wall U-factor of 0.07 would be excellent if it represented the entire wall loss. However, it never does; the overall heat-loss factor of the wall is usually considerably greater than 0.07 due principally to the effect of window and door areas and also to the effect of the lumber, or framing, which forms the skeleton of the wall.[3]

Although orientation of the house, distribution and location of the glass areas with respect to the sun, and type of heating system used also have significant effects on wall heat loss, only direct thermal loss (excluding infiltration) through the wall structure will be considered in the following discussion.

Parallel Heat Paths

Fig. 2 shows the framing of a typical 12- by 8-ft wall with provisions for an 8-sq-ft window. All framing shown presents a 1⅝-in. edge toward the room except the lintel above the window, which is 3⅝ in.

FIG. 1. Frame Wall Heat-Loss Factor



	Resistance
Inside surface	0.68
Gypsum board, ½ in.	0.45
Insulation, $3\frac{5}{8}$ in.	12.08
Sheathing, 25/32 in.	0.98
Building paper	0.06
Wood shingles	0.87
Outside surface	0.17
Total resistance	15.29
U-factor = 1/15.29 =	0.07

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[1] The notation "Btuh" is a commonly used abbreviation for "Btu per hour."

[2] See "Electric Heating Forum" No. 3, Sept., 1960.

[3] For an example of a frame wall which improves on the 0.07 factor considerably see "Electric Heat Can Cost Less," *Electrical Construction and Maintenance*, April, 1960 also Example 6, "Electric Heating Forum" No. 2, August, 1960.

wide. Adding up the area of the framing edges facing the room gives a total of 19.3 sq ft.

Since the gross wall area is 96 sq ft, the framing represents 20.1% of the gross area, and the 8-sq-ft window 8.35%. This leaves 71.55% of the wall to which the 0.07 Btuh factor applies.

There are, then, three parallel paths of heat loss through the wall: through the insulation, the framing, and the glass. The total heat loss of the wall is equal to the sum of the losses through each of the three areas:

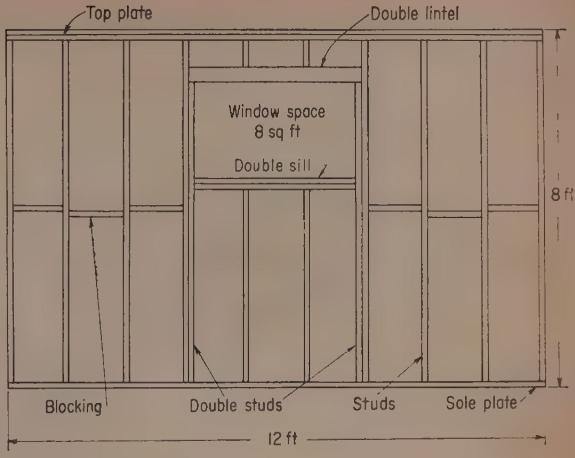
Insulation:
68.7 sq ft x 0.07 Btuh/sq ft/°TD = 4.81 Btuh/°TD
Framing:
19.3 sq ft x 0.13 Btuh/sq ft/°TD = 2.51 Btuh/°TD
Glass:
8.0 sq ft x 0.50 Btuh/sq ft/°TD = 4.00 Btuh/°TD
Total wall heat loss = 11.32 Btuh/°TD
Overall U-factor = 11.32/96 sq ft = 0.12 Btuh/sq ft/°TD

Thus, while the glass area was a mere 8.35% of the gross wall area, it is responsible for 4/11.32 or more than 35% of the total wall heat loss. These relationships are shown graphically in the left-hand portion of Fig. 3. (Note: Double glass is assumed for these and all subsequent calculations, using 0.50 Btuh as a representative U-factor.)

If we now double the glass area by assuming two 8-sq-ft windows in the same 12-ft wall, we get the results shown in the right-hand portion of Fig. 3. Now the glass is responsible for over 53% of the total loss, and the portion of the wall to which the insulation is applied is responsible for only 27.3%.

The curves of Fig. 4 show the variation in framing and glass areas for 8-, 12-, 16-, and 20-ft walls of the type pictured in Fig. 2 having no windows or one, two, or three windows, each 8 sq ft in area. Note that the framing area increases with the number of windows, because of the double studs, sills, and lintels required.

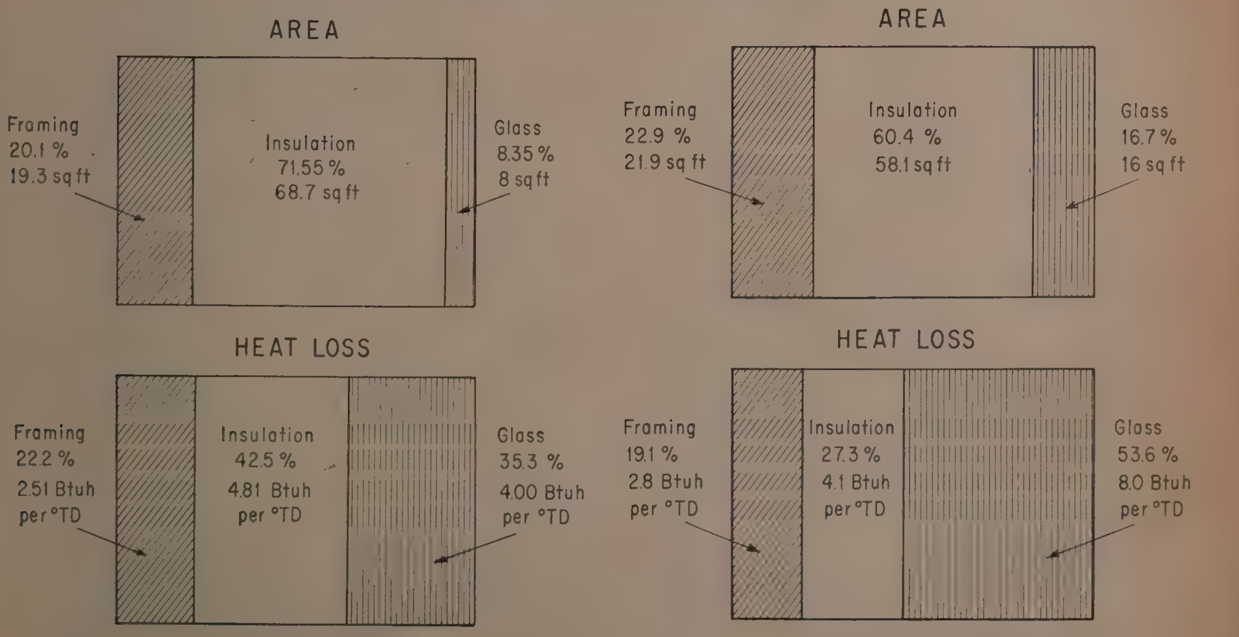
FIG. 2. Ranch-Type Wall Framing



Using these curves and following through with calculations similar to those explained above give overall U-factors for all the wall-and-window combinations of Fig. 4. The results are plotted in Fig. 5.

A study of the curves of Figs. 4 and 5 shows that definite relationships exist between glass area, framing, and overall U-factor. If we restrict the U-factor to two decimal places, we can accurately predict the overall U-factor of a fully insulated 2 by 4 frame wall with an 8-ft ceiling height if we know the percent glass area, regardless of the length of the wall. These relationships are given by the curves of Fig. 6.

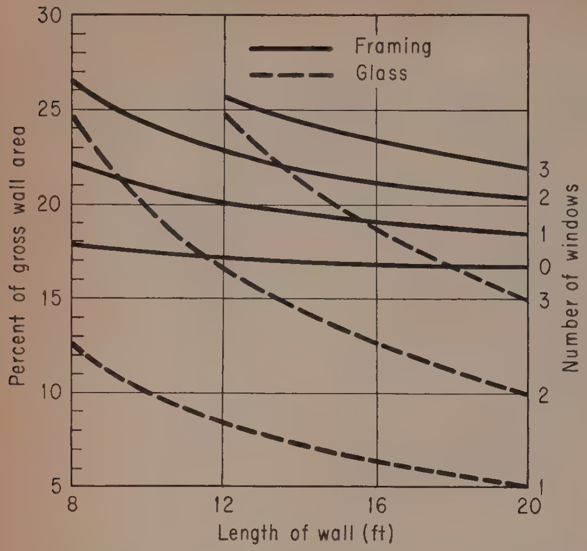
FIG. 3. Effect of Glass on Heat Loss



12-FT WALL; 1 WINDOW

12-FT WALL; 2 WINDOWS

FIG. 4. Glass and Framing Areas, Typical Walls



Use of Overall U-Factors

Fig. 6 permits rapid determination of wall heat loss without resorting to detailed glass, door and wall computations. Note that these overall U-factors recognize the effect of framing, which is too often neglected in heat-loss calculations.

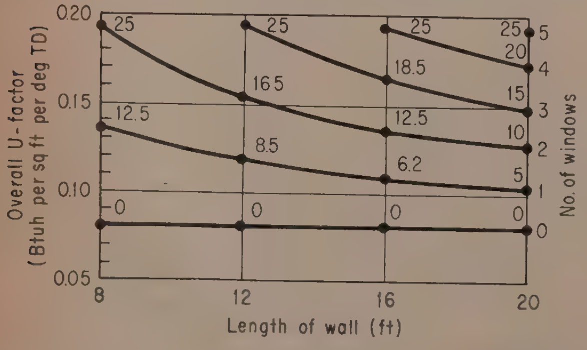
Example 1:
Find the total heat loss through a fully insulated 10-ft wall. Ceiling height = 8 ft; there is one 3 x 4-ft window with storm sash. Design temperature difference = 70 degrees.

Solution:
Window area = 12/80 or 15%; Overall U-factor = 0.15 (from Fig. 6). Total heat loss = 0.15 × 80 sq ft × 70 deg = 840 Btuh (246 watts).

Example 2:
How does the accuracy of this short-cut method compare with a detailed calculation?

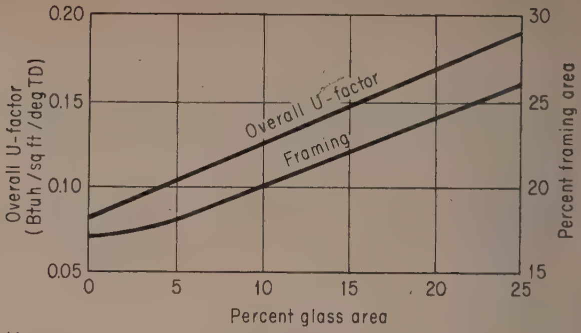
Solution:
Considering each of the three parallel paths of heat loss:

FIG. 5. Overall U-factors, Typical Walls



Note: Numbers on curves give percent glass area at points indicated.

FIG. 6. Overall U-Factors vs Glass Area



Notes:

1. The curves apply under the following conditions:
   (a) Ranch type 2x4 construction used.
   (b) Ceiling height=8 ft.
   (c) Stud space filled with insulation (mineral wool or equivalent).
   (d) Glass areas fitted with storm sash and weatherstripping.
2. Framing percentages are included here only as a guide in making general wall calculations corrected for framing loss. While "picture" windows may have slightly less vertical framing than two or more smaller windows of equal area, the depth of the lintels will be increased to adequately support the longer spans; therefore the percentages shown here should be sufficiently accurate for most purposes.
3. Although the U-factor of outside doors with storm doors usually can be brought below that of windows with storm sash, outside doors can be included reasonably with glass area in these general heat-loss estimates.

Framing: 22%; 17.6 sq ft; U = 0.13
17.6 × 0.13 × 70 = 160 Btuh
Glass: 15%; 12 sq ft; U = 0.50
12 × 0.50 × 70 U = 420 Btuh
Insulation: 63%; 50.4 sq ft; U = 0.07
50.4 × 0.07 × 70 = 247 Btuh
Total: 160+ 420 + 247 = 827 Btuh (242 watts).

Thus the error involved in the short-cut method is 13/827 or 1.6%, on the high side.

On the other hand, the usual method of calculating the wall loss is to neglect the framing entirely, considering only two parallel paths of heat loss:

Glass: Same as before = 420 Btuh.
Insulation: 85%; 68 sq ft; U = 0.07
68 × 0.07 × 70 = 333 Btuh.
Total: 420 + 333 = 753 Btuh.

Here, the error is 74/827 or 9%, on the *low* side.

Conclusions

Although the All-Weather Comfort Standard lists 0.07 Btuh as the maximum U-factor for frame walls in order to obtain "comfort" and "operating economy," it is apparent that walls insulated to this degree may have an overall heat loss of anywhere from 0.08 to 0.19 Btuh and up, depending upon the window area. The heating designer or installer must be able to evaluate these effects quantitatively to provide accurate estimates and reliable recommendations. These factors should be pointed out to the homeowner before construction.

The relationships expressed by the curves of Fig. 6 permit rapid and accurate determination of wall heat loss based on glass area where (1) standard ranch-type 2 x 4 frame construction is used; (2) ceiling height is 8 ft; (3) stud spaces are filled with insulation; and (4) all glass areas are fitted with storm sash. These conditions are met by a great proportion of today's electrically heated homes.

Heat Pump Compressor Capacity Test

By E. E. Umlang,
Texas Power & Light Co., Dallas, Tex.

A procedure for determining whether the compressor for a heat pump installation is operating at rated capacity.

A QUICK and accurate method of checking heat pump compressor performance has been developed in our Test Division which is applicable to standard residential or small commercial installations having a self-contained kilowatt-hour meter.

The capacity of a compressor may fall below its rating for several reasons. However, before proper servicing can be accomplished to remedy the condition, the loss in performance must be recognized. When the unit is operating on the cooling cycle, reduction in cooling effectiveness may be readily apparent. But on the heating cycle, where auxiliary resistance heaters are used to supplement the compressor, the resistance units will very likely take over and provide the heat necessary to make up for the compressor deficiency. Although unusually high kilowatt-hour consumption may be an indication of trouble, the change is often masked by variations in weather conditions or user heating requirements.

The procedure detailed below, requiring only two identical thermometers (5½-in. glass), a watch, a flashlight, and preferably two persons, has been in use in our department since early this spring and has led to the discovery of several units either low on refrigerant or with other minor difficulties causing inefficient operation.

As an interesting by-product of these tests, it was found that the data could be used also to check the performance of the air-handling unit. By substituting known values in the air heating formula rearranged in the form

$$\text{cfm} = \frac{\text{Btuh}}{\text{TD} \times 1.08},$$

where cfm = air volume (cu ft per min)
Btuh = heat supplied by compressor (Btu per hr) and
TD = difference in temperature between air entering and leaving unit (deg F),

the volume of air circulated in the heated area can be easily determined.

TEST PROCEDURE

1. Select a time when (a) the miscellaneous electrical load in the occupancy can remain constant and (b) when the outside temperature is less than 40F—preferably at or below freezing.
2. Insert thermometers through test holes in duct on the suction side of the air handling unit and on the discharge side beyond the auxiliary strip heaters. (Sometimes this can be done through holes made in the ducts by the installer—or, if a return and/or supply grille are very near the unit, the temperatures at those points may be used without too much error.)
3. With the compressor operating but with auxiliary heaters de-energized, measure the temperature of the air leaving the unit, and record the following:
   Temperature difference (deg F)................(A)
   Speed of kwhr meter disc (rpm)...............(B)
4. Raise thermostat setting so that auxiliary resistance heaters begin operating. After a few minutes, when the discharge temperature becomes stable, take readings again:
   Temperature difference (deg F)................(C)
   Speed of kwhr meter disc (rpm)...............(D)
5. From nameplate of kwhr meter, determine the meter disc constant K_h. (This will normally be a value such as 3.6, 4.0, 7.2, etc.)
6. Calculate the input to the auxiliary heaters:
   $$\text{Input (kw)} = \frac{(D) - (B)}{1000} \times 60 \times K_h.$$
   (This should be reasonably near the rating of the heaters.)
7. Determine the heat supplied by the auxiliary heaters:
   Heat (Btuh) = 3413 X kw.....................(E)
8. Determine the heat supplied by the compressor unit:
   $$\text{Heat (Btuh)} = \frac{(A) \times (E)}{(C) - (A)} \quad \ldots\ldots\ldots\ldots(F)$$
9. Compare (F) with the nameplate rating of the compressor unit for the outside temperature and return air temperatures used in the test. If the calculated value is not relatively close to the unit rating, there is probably trouble with the unit.

Caution: It is possible that unusual conditions in the system could produce inconsistent results, in which case more elaborate tests would be necessary.

Cost Comparison: Heating Fuels and Electricity

ALWAYS of interest in the application of electric heat is the cost of electricity with relation to the cost of competing fuels. The data in this table, taken from the June 1959 report on "Retail Prices and Indexes of Fuels and Electricity" issued by the U. S. Dept. of Labor, is presented here to show residential price variations in 20 U. S. cities. (Absence of data indicates that it was not available.)

The chart below was plotted from data contained in the price index summary issued in Oct., 1958, and in later supplements. It indicates clearly the trend of residential heating fuel and electricity prices. These indexes are based on prices collected in 46 cities for electricity, 28 cities for gas, 20 for fuel oil, and 8 for anthracite coal. Although the cities covered have varied over the years, the indexes have been computed in such a way as to maintain the continuity of the series. The period 1947 to 1949 is assumed to represent an index of 100.

Heating Fuel and Electricity Costs—June, 1960[1]

City and State	Natural Gas 100 Therms	Fuel Oil[2] 100 Gal	Electricity		
			40 kwhr	100 kwhr	200 kwhr
Atlanta, Ga	8.52	.....	1.86	3.73	5.81
Baltimore, Md	.....	13.99	2.19	4.32	7.30
Boston, Mass	.....	14.48	2.83	5.30	8.34
Chicago, Ill	.....	14.08	2.05	4.15	6.44
Cincinnati, Ohio	8.11	.....	1.68	3.41	5.76
Cleveland, Ohio	6.68	.....	1.79	3.60	5.85
Detroit, Mich	7.92	.....	2.02	3.85	6.59
Houston, Tex	7.36	.....	1.44	3.05	5.12
Kansas City, Mo	5.73	14.84[3]	2.19	4.23	6.94
Los Angeles, Calif	6.69	.....	1.76	3.27	5.18
Minneapolis, Minn	10.07	14.43	1.93	3.86	6.75
New York, N.Y	.....	14.61	2.74	5.20	8.08
Philadelphia, Pa	.....	13.99	2.37	3.93	5.80
Pittsburgh, Pa	8.03	.....	2.29	4.11	6.19
Portland, Ore	12.94	15.30[4]	1.40	3.25	4.85
St. Louis, Mo	8.50	14.69	2.04	3.57	6.12
San Francisco, Calif	5.73	.....	2.10	3.81	6.14
Scranton, Pa	.....	.....	2.44	4.68	7.43
Seattle, Wash	.....	17.16[4]	1.20	2.52	3.92
Washington, D.C	13.89	14.08	1.84	3.30	5.73

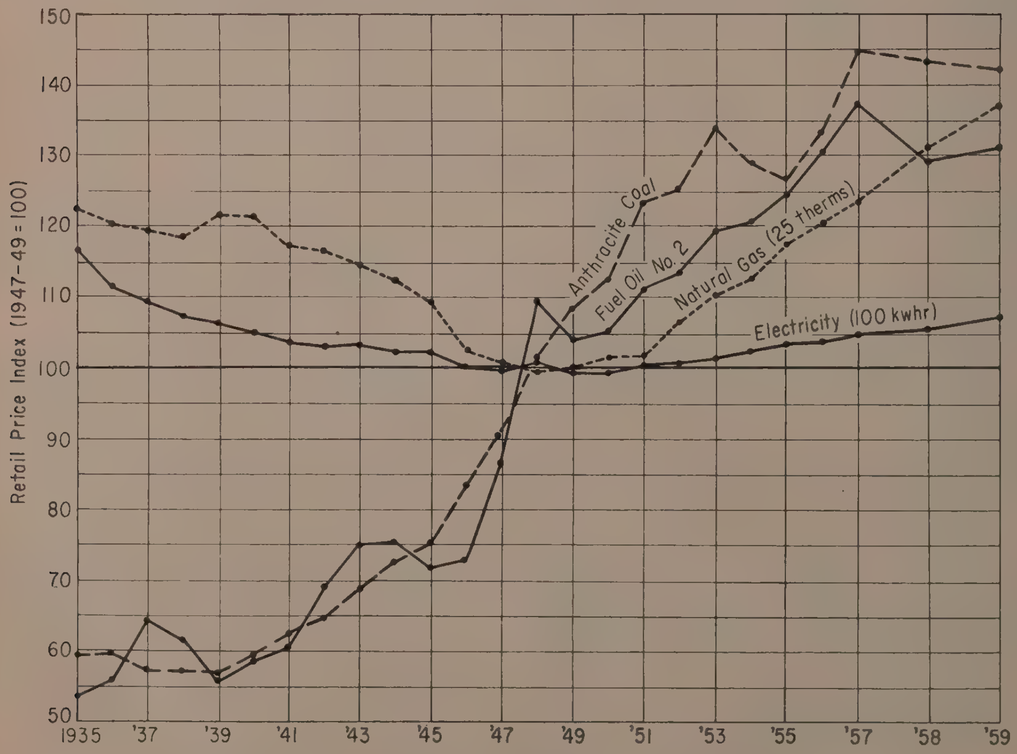
[1] U. S. Dept. of Labor, Bureau of Labor Statistics

[2] Fuel Oil No. 2, except as noted

[3] Fuel Oil No. 1

[4] Fuel Oil No. 200

Price Indexes, Residential Heating Fuels and Electricity



EARLY EVENING time exposure shows how traffic moves smoothly without stops down Marion's main artery, South Washington St. Progressively controlled traffic lights allow a vehicle to proceed without stop at the rate of 20 mph.

A CASE STUDY OF . . .

Modernizing Traffic Signals

Marion, Ind., eliminated Stop and Go driving in their downtown area by modernizing traffic signals. Besides speeding up the flow of traffic, the new system provides added protection for pedestrians.

By Robert C. DeKay, *Asst. Traffic Control Sales Manager, Crouse-Hinds Co., Syracuse, N. Y.*

STOP and go driving on city streets and thoroughfares is a source of irritation to motorists, and the resulting congestion makes it hazardous for pedestrians. Aside from these common complaints about slow-moving city traffic, there is the more serious effect of strangling downtown areas. Serious economic losses in the form of lost business and reduced property values face cities that do not take steps to provide for increased traffic flow.

The city of Marion, Ind., faced this problem a few years ago, and after studies by traffic engineers, a one-way street pattern was adopted. While this move helped, and the one-way routing plan was further expanded, it was readily apparent that maximum efficiency could not be achieved with the existing traffic-signal system.

Vehicular traffic through downtown Marion's 12 main intersections was regulated by independently operated, pre-timed traffic controllers at each intersection. Because there was no interconnected traffic-control system, constant start and stop driving was unavoidable, and traffic piled up in spite of the one-way plan. Moreover, the old traffic-control system did not include pedestrian controls. And most of the intersections had only three pedestal-mounted lights—instead of four signals and double-vision faces at principal intersections—as recommended by the Institute of Traffic Engineers and the Bureau of Public Roads. Since most of the power supply fed from overhead wires, supported by wooden poles, appearance was also a consideration.

City officials decided to replace and modernize the system completely, in 1959. George F. Young, Engineer of Traffic Signals, Indiana State Highway Department, super-

INSTALLATION REQUIRED continuously operating traffic signals. Old traffic lights continued to operate until the new signals were operating; then the old signals were removed. Photo shows old signal being removed. New signal is in operation behind it.

UNDERGROUND CONDUIT was rammed hydraulically underneath sidewalks and streets to eliminate the need for excavations. Approximately two miles of power cable and interconnecting signal wire plus 3350 ft of steel conduit were used in the installation.

INTERLINKED TRAFFIC CONTROLLERS operate the signals. Two signal-timing dials provide flexibility in varying the timing to accommodate varying amounts of traffic movement. Additional flexibility is possible by adding a third dial to provide another timing cycle. Space is also available for the addition of other equipment later on.

vised the design of the system and prepared the specifications. The Welsbach Corporation, through their Indianapolis district office, handled the construction work.

New Traffic Controls

Principal feature of the new installation is the progressive control of the system, which allows the free flow of vehicular traffic through the city's main arteries, South Washington St. and Adams St. Ten new, interlinked, three-dial controllers time the program of progressive light changes and provide a free flow of traffic. Powerful low-speed synchronous motors (essentially clocks) drive the dial units, and the programmed light changes are executed by closing contacts. This energizes a motor-driven, automatically indexed camshaft that closes appropriate signal contacts to change the lights and pedestrian signals. Varying time intervals on the dial units, and resetting the replaceable lobes on the camshaft,

ONE OF SEVEN handholes installed by the contractor to provide access to spliced joints in the signal interconnecting wiring system is shown. Cast-plastic splices provide freedom from moisture problems.

CHANNELIZING ISLAND brings pedestrians comfortably and safely to the edge of the moving traffic area. Neon "Wait-Walk" pedestrian signals provide additional safety for both pedestrians and drivers.

provide complete flexibility in both timing and color sequence.

Only two of the dials, each controlling the lights on a different schedule to accommodate variations in traffic flow, and one reset, to check and maintain the progressive timing of the green indications, are currently used. The extra dial and two more resets provide for future expansion and flexibility of the system. These controllers are the same type as used in the progressive traffic-control systems in New York, Chicago, and Los Angeles, and they are set to provide continuous green at vehicle speeds of 20 mph. One controller dial handles normal traffic flow, and the other, which provides longer greens on the main streets, operates during rush-hour peaks to permit added traffic flow.

Method of Changeover

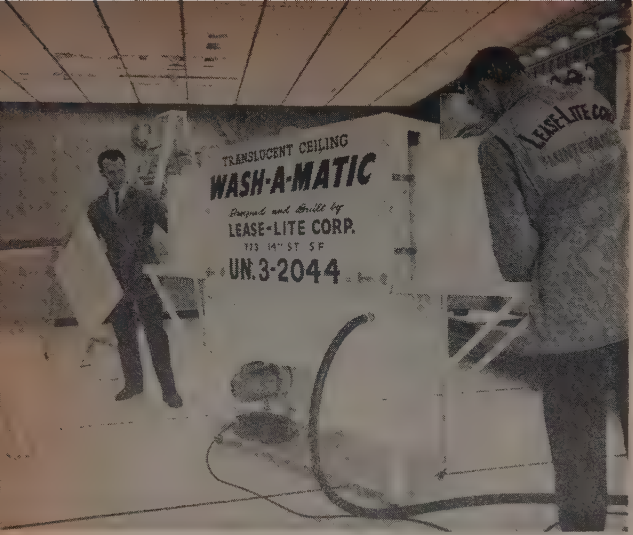
With the exception of a few modern signal faces, all the existing equipment was removed, and 28 new pedestal poles were erected to support the new signal faces and the "Wait-Walk" pedestrian-control signals. Installation specifications provided that no two signals at adjacent intersections could be out of working order at the same time. This problem was solved by allowing the old signals to operate until the new signals at the intersection were in operation, after which the old signals were removed.

Current feeds into the system at five different points in order to keep runs of the 2-conductor No. 8 power cable reasonably short. Service from the utility runs in 1-in. steel conduit to weatherproof, 2-pole, fused, 30-amp entrance switches at each power pick-up point. Power from these switches is carried underground by 2-conductor No. 8 cable in 2-in. steel conduit to the controllers.

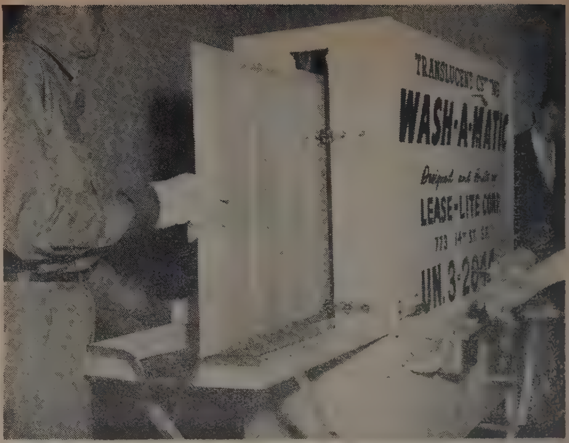
All power and signal interconnecting cables run underground in 2-in. steel conduit, with the exception of one run on messenger wire, which is carried on top of utility company steel beams. Approximately 3350 ft of 2-in. conduit was hydraulically rammed under streets and sidewalks. All cables, both power and 7-conductor No. 14 interconnecting cable, run in continuous lengths without splicing between terminals, except at handholes, junction boxes and pedestal bases. Color-coded conductors are used throughout the installation.

The wiring of the 28 new signal faces, 44 "Walk-Wait" neon warning signals, and the interconnection of the controllers required close to two miles of multi-conductor cable. Also involved was the construction of 28 concrete pedestal bases; ripping up and repair of sidewalk areas; construction of four pedestrian-channelizing islands; construction of seven 30-in. concrete handholes; and the removal of the old span holes, formerly used for carrying power to the old system.

Completed in less than 60 days, the new integrated system in Marion has successfully eased the problem of increased vehicular traffic, common in most cities.



SELF-CONTAINED washing machine is compact assembly that can pass through normal doorways and elevator entrances. Long hose and electrical connections permit obtainment of water and power from distant locations, thereby making it possible to move machine to any convenient work area. Since enclosure prevents internal spray from wetting surrounding area, premises are kept relatively neat and dry at all times.



GUIDE EXTENSIONS, hinged to either end of washing enclosure, flip up to provide elongated trough for support of translucent panels being subjected to cleaning cycle. Stainless steel roller guides on either side of entrance and exit slots can be adjusted to accept panels of varying thicknesses, while neoprene curtains prevent internal splashing from escaping from enclosure.

Dry Wash Makes

Lighting maintenance partnership in San Francisco designs self-contained wash tank that automatically applies wetting agent, detergent, rinse spray and destaticising application to luminous-ceiling panels without requiring local water source and without wetting the premises.

WASHING luminous ceiling panels on a customer's premises without making any splash and without requiring a convenient water supply is quite a trick. Yet two fellows in San Francisco are doing just that, giving panels the full treatment of wetting agents, detergent sprays, scouring brushes, rinsing and anti-static applications without muss or fuss. In other words, *they* are making a big splash in the lighting field by keeping their customers' premises dry.

This apparent contradiction is achieved by the Lease-Lite Corporation through use of a unique piece of equipment developed by partners Larry Creech and Steve Cohen. The machine accepts dirty panels at one end and delivers them clean, ready for re-installation, at the other end in a continuous operation that fully justifies the name of Wash-a-Matic.

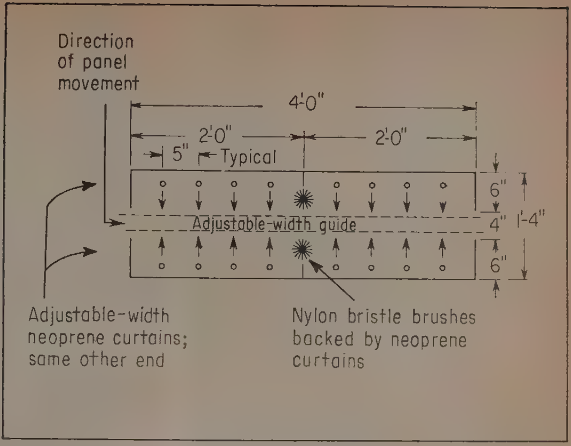
Since the compact machine has an overall height of 5 ft, width of 16 in. and length (with panel-guide extensions lowered) of only 4 ft, it can easily pass through normal doorways and elevator entrances. And, since the assembly is provided with very long hose connections and power cables, it can be set up at any convenient work center, with power and water being supplied from remote points. In fact, when the writer checked on the operation, water was being brought up a stair well from a janitorial service closet located *two floors below.*

In plan the unit is not unlike an auto-washing booth. Translucent panels first enter a compartment, wherein a wetting agent and detergent is applied to both sides simultaneously through series of closely spaced spray nozzles. Panels then pass between vertical nylon brushes that dislodge dirt and grime without marring or scratching the plastic surfaces. A second major compartment, equipped with spray nozzles, then subjects panels to a continuous rinsing action. And finally, with a destaticiser applied, the drip-dry panels then slide out onto a guide extension, ready for stacking or immediate replacement in the suspended supporting grid of the lighting system.

Guides and all other components coming in contact with panels are of stainless steel to preclude staining, while width of guide slots can be regulated to accommodate either thin plastic sheets, corrugated rolls or double-wall hollow panels.

As panel guides are adjusted in width, so also are neoprene curtains located at both ends and at the unit's midsection (behind the vertical brushes). These adjustments prevent internal spray

RESERVOIRS, VALVES and gauges are provided for storage, control and indication of detergent and destaticising additives. Water pressure is maintained by a pump mounted beneath enclosure. Detergent is recirculated although rinse water is immediately carried away by exhaust hose. Casters permit unit to be moved easily. Still in development stage, details of machine are being improved constantly.


Direction of panel movement
4'-0"
2'-0"
2'-0"
5"
Typical
6"
Adjustable-width guide
4"
1'-4"
6"
Adjustable-width neoprene curtains; same other end
Nylon bristle brushes backed by neoprene curtains

ARRANGEMENT OF ENCLOSURE suggests typical car-wash booth, since translucent panels pass between vertical jet streams set at close intervals; a wetting agent and detergent being pressure-sprayed against both sides of panel in first section of booth while continuous rinse action takes place in the second half of the enclosure. Nylon brushes dislodge dirt while adjustable neoprene curtains contain splash action.

Big Splash

from splashing outside the machine's enclosure, and also prevent detergent from spraying past the brushes into the rinsing compartment.

In this cleaning cycle, detergent and rinse water alike are projected under pressure. Self-contained pumps rated at 80 gpm are used for that purpose.

As sprayed detergent drips from panel sides, it is collected in a sump, then enters a pump intake for recirculation and reuse. And, as the supply of detergent is diminished through the normal process of partial carry-over into the rinse compartment, the supply is replenished from a convenient reservoir. Level of detergent may be checked by gauge while emission of detergent is regulated by a manual valve. Detergent, wetting agent and destaticiser were specially formulated for use with plastics, while rate of application is adjusted in accordance with temperature of the water.

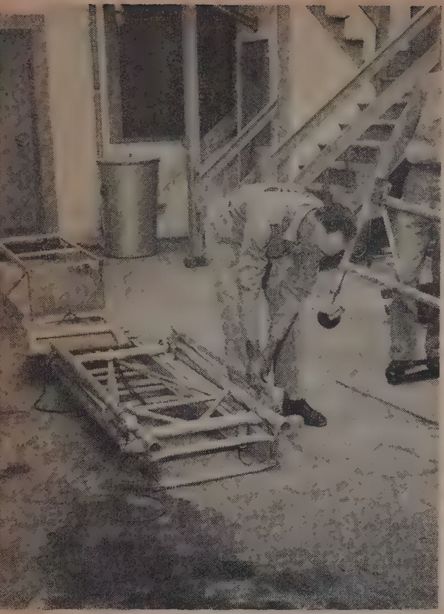
Unlike the detergent, the rinsing water is not recirculated. Supply and exhaust hoses are connected to pump and sump respectively so that water is supplied and removed in a continuous operation.

Prior to the development of this automatic washing machine, panels were washed in open tanks. And, since some splashing and dripping was inevitable, it was impossible to keep the immediate area dry under those conditions. Moreover, when washing double-walled hollow diffusing panels in this manner, leaks or cracks often developed, thereby admitting water into the central cavity of the panels. This infiltrating water was practically impossible to eliminate. One solution was to wash hollow panels with constantly running hoses, although this procedure limited the selection of washing sites due to the related amount of spray and splash.

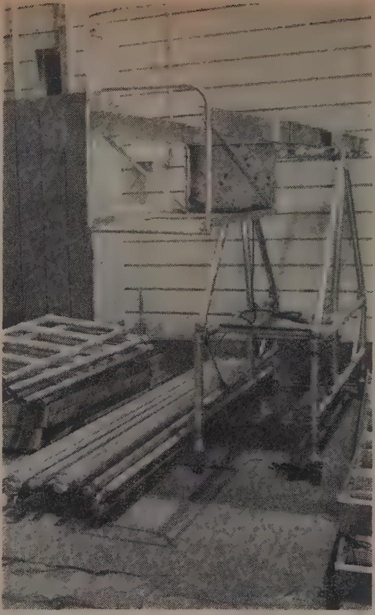
REMOVING AND REPLACING translucent panels is facilitated through use of quickly erected tubular-aluminum scaffold. During interim interval when panels are being cleaned, men on scaffold can clean lamps, note flickering or blackened tubes and replace any defective components. Neat employee uniforms make good impression on customers.

Design of this washing machine was therefore motivated by several considerations, as it was the partners' objective to construct a unit which would: (1) permit washing all types of translucent plastic panels in a single machine; (2) permit washing double-walled hollow panels without having to submerge them; (3) develop a compact washing center which could be moved easily to any desired location; (4) provide sufficiently long hose and cable connections to permit obtainment of water and power from remote sources; and (5) develop a method whereby the destaticising application would not be nullified by a final rinse, or unnecessary handling of panels while wet.

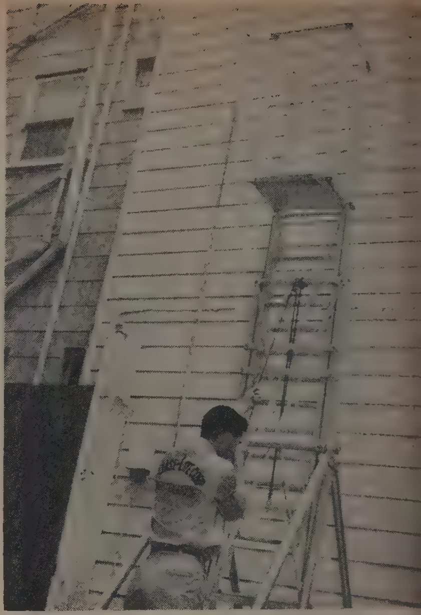
This revolutionary and logical method of panel-washing promptly attracted local attention because, with specialized equipment being used in standardized, repetitive routines, it became clearly apparent that large volume installations



HIGH-LEVEL LIGHTING installations can be reached easily by lightweight tubular aluminum height-adjustable working platform that collapses compactly for racking atop service truck and convenient transportation to maintenance jobsite, where it can be . . .



ASSEMBLED BY SINGLE MAN in space of a few minutes. Outrigger construction of unit provides stability, while casters on legs facilitate movement, or may be locked to prevent movement. With pivoted ladder in horizontal position . . .



WORK PLATFORM can be rolled through normal-height doorways, then tilted and locked in vertical position. Upper section of platform assembly can be raised like a typical extension ladder, while spring-activated hook-locks prevent raised platform from slipping.

could be handled more cleanly, more quickly and more economically than previously.

"Proof of the pudding" has been a steady increase in business that was promoted partially by a full-time salesman but (more important), also promoted by voluntary word-of-mouth testimonies from satisfied customers to other prospects. As a result, numerous contracts, theoretically, have been unsolicited.

This lighting maintenance business falls into a definite class pattern, because Lease-Lite concentrates on installations which are essentially commercial, fluorescent, translucent, and interior in nature. Outside lighting installations and industrial jobs are handled to a limited extent, but the majority of their work is related to offices, banks, schools, markets, showrooms, hospitals, hotels and similar occupancies.

Many of these contracts are sizable. As for example, a contract involving over 100 branch offices of the Bank of America, and a blanket contract with Woolworth Stores to maintain lighting installations in that company's many northern Californian outlets. In addition, a good number of contracts fall into the category of "one shot" jobs, wherein customers wish their lighting installations placed in top condition. In these in-

SERVICE TRUCKS are compact in design, with wide bi-parting doors on sides and flip-up rear panels providing liberal access to equipment and materials carried inside. Racks on top of vehicles support ladders and scaffolding, while interior bins and racks safeguard lamps and meters being carried to jobsites.

FLEET OF COMPACT service vehicles, special ladder truck (out on assignment when this photo was snapped), station wagon and conventional passenger cars are used for different purposes by Lease-Life. Majority of work is located within 20-mile radius of San Francisco headquarters, although several large contracts are as much as 400 miles distant.

stances, maintenance on a continuing basis is not initially contracted for, although many such jobs have eventually led to a continuing program of cleaning and relamping.

Upon signing contracts, installations are first classified according to location, nature of ceiling construction, areas to be serviced, working heights and availability of water and power. A typical contract likewise makes note of the type of translucent panel involved; whether relamping is to be on a group-replacement or spot basis; whether the customer or the maintenance company is to supply the lamps; the inclusion of emergency call-back service if that is desired; the cost per foot and total cost of the contract, and the right (on the part of the maintenance contractor) to review the terms of the contract every two years in order to reconsider unit costs of labor and material involved. The contract is then assigned a route number, maintenance frequency and time of day, because work is performed at the convenience of customers, a procedure that places a heavy concentration of work on late-afternoon, evening and Saturday schedules when normal business of customers will not be inconvenienced.

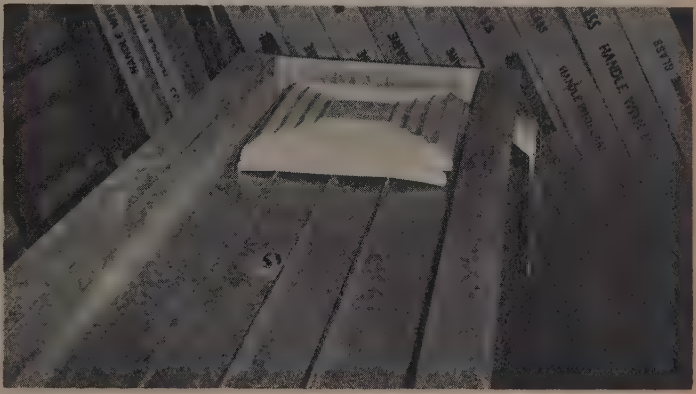
To handle these assignments, Lease-Lite maintains a central business office; a large stockroom and yard for the containment of scaffolding, washing tanks, cleaning agents, lamps, ballasts, starters and the like, sufficient for "normal" supply; an additional (remote) warehouse for the bulk storage of components; also a fleet of compact service trucks which are stocked for each specific job, or for a normal day's operations.

Equipment carried to job sites includes not only lighting system components and cleaning agents, but instruments as well; instruments such as lightmeters and voltmeters to check power system characteristics and obtained light output of the system before and after reconditioning. Service personnel, provided with neat and frequently laundered uniforms, are trained not only to clean lamps and panels, but to inspect and replace defective components in the overall system. And supervisors are trained to inspect jobs, determine necessary equipment and designate job routines which will accomplish the work with maximum efficiency and minimum interruptions to customers. In this connection, it is pertinent to note that drop cloths, special scaffolds and special ladder trucks are regularly employed. In this connection, the partners are high in their praise of a collapsible aluminum working platform that can be assembled easily by one man, rolled into position and raised to the desired working height, as indicated by accompanying photos.

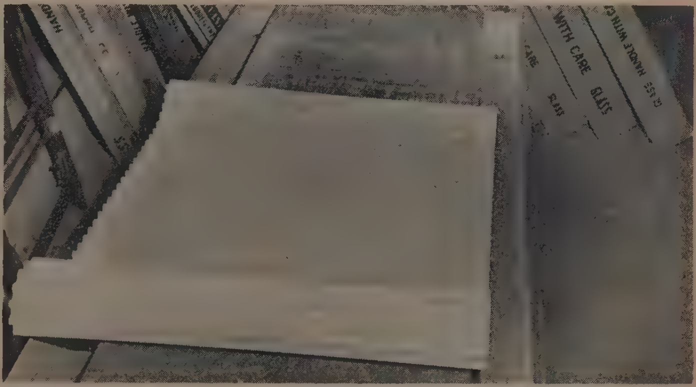
While most contracts are located conveniently within a 20-mile radius of headquarters, a good number are located within a 125-mile radius and are serviced on a "circuit

(Continued on page 246)

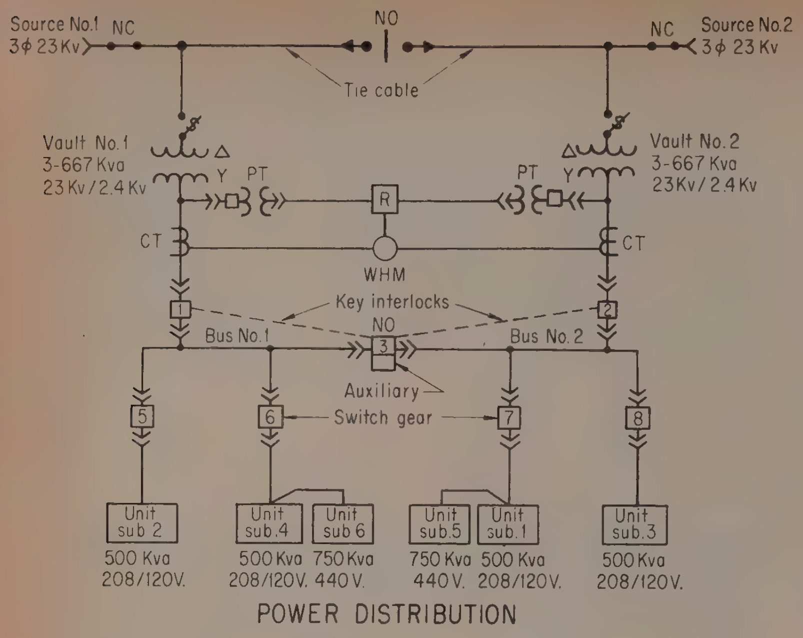
INACTIVATED, when enclosed cleaning tank was developed, are such formerly-used items as pails and sponges, rubber boots and trousers, rubber gloves and mop-mitts shown in this photo. At right is small portable vacuum cleaner; still employed to remove dust from tops of fixtures prior to washing, thereby reducing by-products of dust falling from fixtures (when wiped or dusted) or dirty water (due to excessive dirt residue).



CONSTRUCTION of this long wash tank is unique in that it can be used in this position, with central-recessed tank section containing plastic panels, or it can be flipped over so that . . .



CENTRAL SECTION IS RAISED, while side troughs catch water as it runs off corrugated plastic continuous panel strip. In both photos, note that drainage connections are provided at the lowest elevations.



INCOMING 23-KV SUPPLY enters the building at two points. As shown in the one-line diagram, each transformer bank consists of three 667-kva transformers. Here the voltage is converted from 23 kv to 4.16 kv. Medium-voltage switchgear has two incoming sections, a tie, an auxiliary section, and four outgoing feeder sections. Normally-open tie CB is key-interlocked with the two incoming primary breakers.

Rewiring Highlights At Carnegie Museum and Library

Pittsburgh's Carnegie Museum and Library undergoes complete reconversion from self-generated dc power to utility-purchased ac power.

By Joseph T. Danko, *Consulting Electrical Engineer, Pittsburgh, Pa.*

PLANNING a new electrical system for a famous building offers an interesting challenge. Each problem must be solved on an individual basis, blending in the new equipment to match existing architectural features and mechanical objectives.

At the turn of the Twentieth Century, Andrew Carnegie provided a grant of about $6 million to construct a library and museum in honor of the people of Pittsburgh, who made the city the steel center of the world.

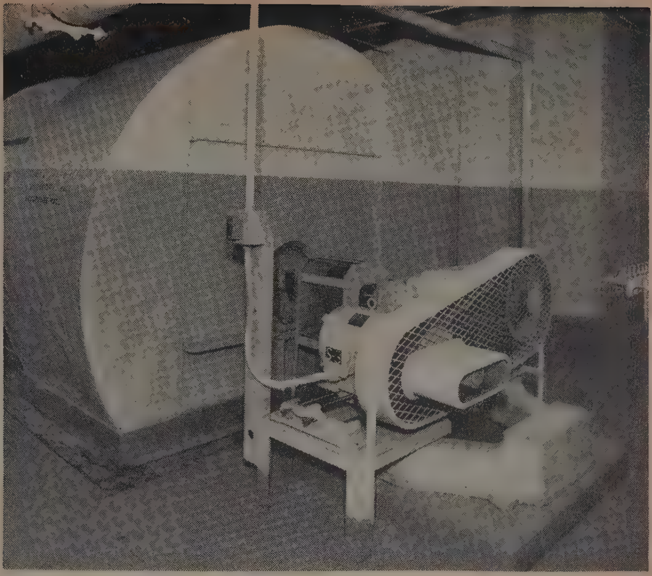
Today, after years of continuous public service, with Library, Museum, Fine Arts, Music Hall and Education Divisions, the building stands well preserved as an attractive institution in the Oakland Civic Center. However, the mechanical and electrical systems had shorter lives for the wear, tear and obsolescence began to show up noticeably.

To understand the extent of the electrical modernization program decided on by the Carnegie trustees, the heart of the original installation consisted of five 300-kw dc, 115-volt generators, each steam-engine driven. These compound-wound generators were operated in parallel and controlled from a marble-backed switchboard under constant supervision of a skilled attendant.

Another feature was the amount of copper used between the five generators and the switchboard. Nine runs of 1900 MCM cables in nine 3-in. conduits were provided. From the switchboard, individual feeders supplied the panelboards. One typical run was four 400 MCM conductors in two 3-in. conduits that served a panelboard some 500 ft away. Average feeder length was 360 ft.

The building has three floors open to the public, but there is also a full basement, sub-basement and attic, which contains mechanical and electrical equipment.

CENTRAL CONSOLE controls all house and stage lighting. Console has three presets and a master fader. Plug-in potentiometer controllers contain their own dial light, which illuminates the scale and color handles for color lighting circuits.



SUPPLY FAN installation shows adjustment-speed equipment with a 15-hp, 3-phase, 440-volt motor in view. Pushbutton switch shown in the feed to the motor is the lock-out type, and is connected in the holding-coil circuit of magnetic starter. Installation is typical of the changes required in converting electrical system from ac to dc.

After cost and feasibility studies by the architect and engineer, Charles M. and Edward Stotz, and the writer, who was their consulting electrical engineer, the working plans for the complete reconversion from dc to the utility ac system were completed. James Devlin, Inc. of Pittsburgh, made the electrical installation.

To effect the dc-ac conversion, major work included transformer vaults for the two independent incoming supply lines, switchgear, unit substations, motor-control centers, new panelboards, and new ac motor drives with speed reducers. Also, new lighting and controls have been installed in the Music Hall.

Transformer Vaults

Two independent sources of incoming power supply are obtained from independent generating stations and enter the building as independent circuits. As a result, two rooms house the Duquesne Light Co. transformers, primary switches and auxiliaries where the circuits immediately enter the building. Each transformer bank consists of three, 667-kva transformers, using the two-step system of voltage transformation. At each vault, the voltage is reduced from 23 kv to 4.16 kv.

Between the two vaults, a separate room houses the medium-voltage switchgear, which has two incoming sections; a tie; an auxiliary section; and four outgoing feeder sections.

Electrically operated, air circuit breakers control the incoming tie and outgoing circuits. To insure the successful operation of each breaker, we selected a 125-volt storage-battery bank as the energy source for operating the breakers.

During normal operation, the tie circuit breaker is open, and being interlocked with the two incoming primary breakers, may be closed to connect primary bus No. 1 to primary bus No. 2 for operation from one power transformer bank. See accompanying diagram. For maintenance purposes, the utility can serve both transformer banks through their primary switches and tie cable from one substation.

Power Centers

To provide a flexible and reliable distribution system, we located four unit substations in basement rooms, one for each quadrant of the building. They handle the lighting load. Each substation incorporates a 500-kva dry-type transformer and voltages are transformed from 4.16 kv to 208 Y/120 volts, 3-phase, 4-wire.

For power loads, each of two unit substations serves one-half of the building. And each of these unit substations has a dry-type transformer, which changes voltages from 4.16 kv to 440 volts, 3-phase.

All oil-base, rubber-insulated, 5-kv cables between the switchgear and each unit substation are heat, moisture and ozone resistant.

To establish an inspection and maintenance system and to make available an additional alternate source of power to each substation, the unit substations are paired and operate as a secondary selective system.

Each unit substation has a main secondary breaker and is interlocked with a tie breaker, which remains open during normal operation. In the event of a primary feeder outage to any unit substation, an automatic transfer system opens the main breaker of the affected equipment, and closes the two tie breakers of a pair of unit substations.

Each unit substation has enough additional capacity so that when one is out of service, the other will carry essential loads with pre-established curtailing of non-essential loads and a short-time duration overload.

With a system of safety key-interlocked devices and keys as a part of the switchgear, the load-break switch compartment of each unit substation and its secondary and tie circuit-breakers are not accessible while energized.

UNIT SUBSTATION, rated at 500-kva, handles the lighting load in the Carnegie Museum and Library. Four of these units are installed in basement rooms, one in each quadrant of the building. Schematic drawing on the face of enclosure indicates the circuit path from primary to secondary equipment. Note position of main and tie CBs in center of unit.

MEDIUM-VOLTAGE SWITCHGEAR is located between two utility transformer vaults. An accompanying sketch shows wiring connections between equipment. Rack at rear of photo contains batteries, which supply 125-volt dc supply to electrically operated CB mechanisms. Joseph Danko (left), looks over plans with the electrical contractor, James Devlin.

To serve a wide variety of motor drives, we installed seven motor-control centers close to the various loads. Six of these load centers are in the basement, and one is in the attic. However, all starting operations are centralized in the basement. As a result, the attendant no longer needs to walk miles each day to start each individual drive from its respective location.

Motor-control centers have combination-type circuit-breaker starters, each with an individual 120-volt control-circuit transformer. Push-button control stations for remotely controlled drives contain indicating lights.

Large drives, such as the elevator and printing-shop motor-generators are supplied with power direct from the nearest unit substation.

Because of a serving-utility penalty clause for low power factor, we took steps to keep the power factor high enough to eliminate most of the charges paid for kvars. We attained a base power factor of 90% by applying two systems of power factor correction.

For all the elevator motors and a single motor-generator set for the printing shop, rated at 40 or 50 hp, individual, enclosed, dust-tight capacitors of suitable rating are connected directly at the motor terminals. Since the capacitors are in the circuit only when the motors are running, separate switching was unnecessary.

At each motor-control center, an individual capacitor supplies kvars to the group, improving power factor at the main bus to about 92%. Motors served from the control center range from 3 to 15 hp. And they run continuously during the time the building is in use. A circuit breaker at the control center switches the capacitor. During the starting-up and shutting-down periods, the attendant closes the breaker after all units have been started. He opens the breaker before he shuts down the drives.

Panelboards

In converting dc panelboards to 3-phase, 4-wire, 208 Y/120 volts, we used the existing steel cabinets for new panelboard interiors and trim.

Many of the new branch circuits are controlled through remotely operated contactors. Sections of panelboards contain mechanically held ac contactors, which are operated from new remotely located momentary-contact control stations.

We solved the problem of replacing existing panelboard interiors by installing temporary panels and serving them with a temporary feeder. Then the branch circuits were spliced out and connected to the temporary panel. Following this, the existing panel interiors were removed and replaced with new ones. After the permanent feeders were installed, the panels were energized and branch circuits retransferred from the temporary panels.

Prior to the changeover, shunt-wound dc motors powered the mechanical equipment. All these units operated at speeds of 1200 or 1750 rpm except the supply and exhaust fans, which had speed ranges of 100 to 200 rpm. For the latter, a field-rheostat control regulated the speed according to the season of the year.

The low-speed drives have been replaced by totally enclosed, fan-cooled squirrel-cage induction motors, including a shaft-mounted speed reducer with a variable pitch sheave in a combination and adjustable motor base. For those applications where speed adjustment is not essential, the driving and driven pulleys have been mated to give the desired speed with proper belt tensions.

One single application of the eddy-current coupling principle has been used for the Music Hall supply fan to obtain an adjustable-speed drive.

Squirrel-cage induction motors, totally enclosed by direct coupling to the driven unit, replaced all motors in the higher speed range.

Motors in the printing shops have been replaced or overhauled recently, and the dc motors with fine speed control required maintenance. To continue to provide 120 volts dc, a flat compound-wound ac-dc motor-generator of 30 kw output has been provided. This new unit, with controls and an individual capacitor, supplies power to a dc panelboard.

Westinghouse Elevator Co. performed the necessary elevator work brought about because of the conversion to ac supply. Of the seven elevators, only the freight elevator is hydraulic. However, all seven have been converted to ac-dc operation or total ac in lieu of dc.

Four elevators required the replacement of the incoming service switch, the dc-dc unit-frame generator to an ac-dc unit frame generator with a direct-connected exciter, starting equipment, control panel, changes in the hoist motor as well as many accessory changes such as new inductor switches, limits, door safety edges, interlocks, corridor pushbutton stations and other items to comply with the elevator regulations. These elevators have selective-collective control.

The freight elevator required a new machine room in the attic. To conform to elevator code provisions, extensive mechanical work had to be performed. This elevator is used to move 8000-lb capacity heavy painting and museum pieces from the incoming loading dock to all floors.

For another elevator, control has been changed from a 2-button multi-call rheostatic operation to a 2-button, collective, variable-voltage operation.

Because the Music Hall began to be used increasingly for a variety of public performances, it was immediately desirable to improve the lighting.

Relighting of the Music Hall required lighting units and a system to satisfy the visual needs of two groups of people, those in the gallery, and those on the stage. Close collaboration with the architect provided a concept of lighting objectives, which blended with existing aesthetic qualities of architecture.

The proscenium arch originally housed three rows of bare incandescent lamps, one row of which faced the audience. Auditorium seating depended primarily on this light source and wall urns for all visual purposes.

In the stage area, existing proscenium lights had to be removed; openings enlarged; and recessed border lights, beamlights and other luminaires installed. Under the organ pipes, downlights improved the lighting in rear areas of the stage. Also, three sets of disappearing footlights, wired in three color circuits, have been provided.

In the auditorium ceiling near the stage, ten new 1500-watt luminaires, arranged in the form of a horse-shoe pattern, light the front of the acting area. Two 4000-watt follow spots in the projection booth supplement this lighting.

Mounted in the first balcony front, five luminaires illuminate the organ pipes.

For the auditorium proper, recessed-type, multi-ring, silver-bowl fixtures are mounted in several rows under each balcony. Openings had to be provided in the auditorium ceiling panels for recessed downlighting to serve the first-floor seating area.

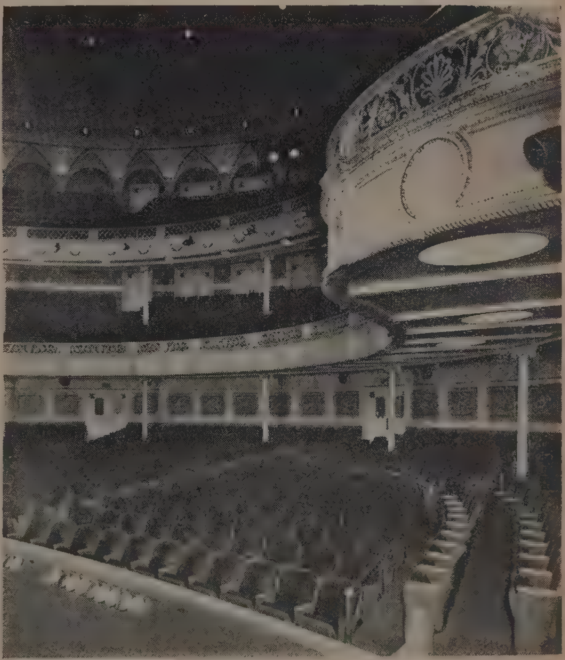
Catwalks, installed above the main auditorium ceiling dome, permit maintenance personnel to service and relamp all fixtures quickly and with ease.

To control the intensity of all Music Hall lighting, banks of dimmers of the magnetic-amplifier type have been located in the basement. A central console, located in a room off the stage, operates the dimmers.

Dimmers are the air-cooled type, consisting of a static core and coil transformer, reactor, dry-disc rectifier and resistor. Each dimmer circuit has a protective circuit breaker and one remotely controlled contactor.

The console has three presets and a master fader. Plug-in potentiometer controllers contain their own dial light for lighting the scale and color handle for color circuits to be controlled.

MOTOR-CONTROL CENTER is typical of seven such load centers which serve 3-phase 440-volt motors. Pushbutton stations on the left control another load center, located in the attic area. Power-factor-correction capacitor is mounted on the side of the motor-control panel.



NEW LIGHTING has been installed in the Music Hall auditorium and stage. Disappearing stage footlights are wired in three-color circuits. Entire auditorium lighting has been replaced with new luminaires. Panelboards contain contactors for switching lighting circuits from remote locations.

OBTAINING EQUIPMENT by leasing rather than outright purchase offers practical solution for financing large, expensive items such as this aerial ladder and truck. Capital conserved by this practice can then be invested more profitably for company expansion.

Financing of electrical contracting activities suggests practical possibilities for . . .

Equipment Leasing

. . . involving both field, construction and office requirements. In fact, having contracted for over $200,000 worth of equipment in this manner, this contractor maintains that leasing provides needed items promptly, when they are needed, without large cash investments; it eliminates the specter of obsolescence; it justifies; specialized equipment for specific applications; and it bypasses headaches of long-term maintenance and storage.

By Robert S. Lauter, *Executive Vice President, Ets-Hokin and Galvin, Electrical Contractors, San Francisco*

IT IS economically true that contracting firms derive profits only from the *use* of equipment, rather than from its ownership. In other words, contractors cannot profit from the mere *possession* of equipment; but only in the *application* of that equipment to promote efficient installation, job-handling and service routines.

In cases where special types of work require highly-specialized items of equipment, outright ownership of such equipment becomes even more questionable from the viewpoint of practical economics. Therefore, acquiring new equipment by *leasing* becomes an attractive consideration.

In the case of a large contracting organization such as Ets-Hokin and Galvin, it is understandable that normal increments of manpower and equipment can constitute prodigious demands on financing. In fact, in the midst of such large-scale operations, it is conceivable that operating capital might become insufficient to meet normal day-to-day expenses related to running this established business, *plus* meeting demands related to opportunities for even greater expansion and service. For this reason, the possibility of obtaining equipment without having to allocate capital investments for direct purchase is extremely attractive.

The acceptance of this philosophy prompted us to examine all possibilities to find newer, more efficient methods for financing our continuing growth. This led to a thorough investigation of equipment leasing.

Obsolescence Factor

In addition to being able to obtain new equipment without having to make huge capital investments, the practice of leasing equipment provides protection against obsolescence, for it is obvious that *all* machinery, including *construction* equipment, is subject to obsolescence.

MONTHLY RENTAL charges, as opposed to sizable initial purchase payments, spreads cost of major items of equipment over long periods, after which new equipment may be obtained under terms of new lease, or old equipment may be retained under reduced rental plan.

Agreements

When machinery is owned, there is the ever-present temptation to "make do" with obsolescent or worn-out gear, rather than replace it with newer and more efficient equipment. In operations where the degree of efficiency is closely proportional to profits, this obsolescence factor alone can be decisive.

We, therefore, conducted several studies to determine relative usage-to-rental factors involved in standard leases available with several good leasing companies extant. And, in our own case, a leasing service offered by the United States Leasing Corporation of San Francisco proved most advantageous.

This company, a pioneer in its field, subscribes to the concept of *engineered* leases. So, after initial conferences, they studied our particular requirements and conditions; beginning with communications-installation gear such as cable dollies, trenchers and plows.

This was a straight-forward proposition; our company selecting items of equipment needed, then notifying the leasing company. In turn, the leasing company then purchased the equipment outright, turned it over to us for use, and notified us of the terms of the leasing agreement. This generally involved a relatively modest payment upon delivery of the equipment, plus additional monthly payments spread over a 5-year period.

At the end of that period, we were offered the option to either continue the same lease at a much lower monthly rental figure, or we could enter into another completely new leasing agreement involving completely new equipment.

For example, we obtained an office trailer costing approximately $5150, although our monthly payments approximated only $100. And, at the end of the leasing term, we had the choice of either returning the trailer and obtaining a new replacement under a fresh agreement, or of retaining the old trailer at a much lower rental figure.

ELECTRIC ACCOUNTING machine with all accessories is obtained under leasing agreement involving monthly payments of $92 over 5-year period. While total rental costs exceeded list price of machine, capital was released for more productive uses.

TIME SAVING calculator was leased for $13 a month, while electric typewriters were obtained under same agreement for $9.50 a month each. These rental charges were partially written off through tax credits, as legitimate operating expenses.

COMPARATIVE COSTS—LEASING VS OUTRIGHT PURCHASE

	LEASING				PURCHASE				LEASE vs PURCHASE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
Year	Rental	Tax Credit 52% of (1)	Net Cash Cost (1) minus (2)	Cum'l. Net Cash Cost	Purchase Price	Depreciation Summation	Tax Credit From Depreciation	Cum'l. Net Cash Cost	Additional Available Cash: (8) minus (4)
0	$8,296 (a)	......	$8,296	$8,296	$200,000 (b)	......	......	$200,000	$191,704
1	49,776	$25,884	23,892	32,188	......	$60,000	$31,200	168,800	136,612
2	49,776	25,884	23,892	56,080	......	48,000	24,960	143,840	87,760
3	49,776	25,884	23,892	79,972	......	36,000	18,720	125,120	45,148
4	49,776	25,884	23,892	103,864	......	24,000	12,480	112,640	8,776
5	41,480	25,884	15,596	119,460	......	12,000	6,240	106,400	13,060 (minus
Sale of Equipment	......	......	......	......	20,000 (c)	......	......	86,400	......
Totals	**$248,880**	**$129,420**	**$119,460**	**$119,460**	**$180,000**	**$180,000**	**$93,600**	**$86,400**	**$33,060(minus**

(a) Deposit
(b) Initial cost of equipment
(c) Equipment sold at end of lease for book value

CAPITAL CONSERVATION through leasing is indicated by this comparison of charges. Differences in the two tabulations indicate amounts of cash, in excess of depreciation recovery, that remain available for use when equipment is leased. Basis of this comparison was actual 5-year lease of equipment having purchase list price of $200,000.

In another instance we obtained an aerial ladder, listing at $4430, although our monthly rental charge amounted to slightly less than $86.

Now, in both of these cases, simple arithmetic indicates that the total of the monthly rental charges adds up to more than the list price of the equipment. However, from the lessee's point of view, there is the advantage of obtaining new equipment immediately, when it is needed, without having to make sizable incursions into capital reserves. Moreover, the money so conserved can, in most cases, be put to more productive use, rather than have it remain static as a frozen asset.

Office Equipment Included

This basic method for procuring *field* equipment proved to be so satisfactory that it was extended to include *office* equipment as well. And, in so doing, we obtained a modern calculator for less than $13 a month; an electric cash register-accounting machine combination with all accessories for less than $92 a month, also electric typewriters for $9.50 a month each.

This method for obtaining modern, new, efficient equipment has been extended to numerous other items as well. And, since we inaugurated the practice of leasing, we have contracted for over $200,000 worth of construction and office equipment in this manner.

These total outright-purchase costs, as compared with actual leasing charges, are equated on an accompanying chart.

Summarizing, the advantages which we have derived from leasing agreements include the following:

1) We have been able to obtain needed equipment without delay and without large cash outlays.

2) We are protected against obsolescence, since we receive the benefits related to new, efficient equipment, although we are not constrained to keep that equipment after its usefulness has decreased.

3) We have been able to obtain equipment for specific jobs without encountering the problem of what to do with it when those specific needs no longer exist.

4) And, since we do not own the equipment outright, we are neither encumbered nor concerned with its maintenance or storage beyond the leasing period.

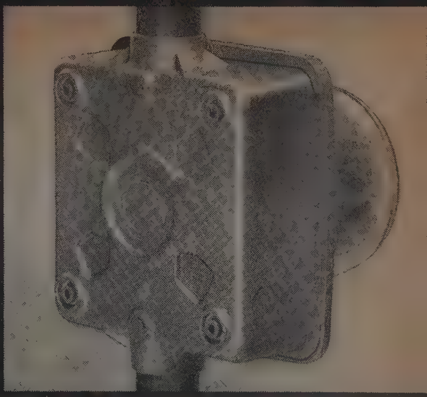
In general, then, we have found that equipment leasing is useful, convenient and economical. It has freed large sums of capital for operating expenses, and it has provided us with a "working surplus" which is essential for expansion and growth. Finally, this leasing practice has provided us with modern tools when they are needed, thereby increasing our capabilities and proficiencies in this highly competitive electrical construction industry.

In our case, equipment leasing has involved considerable diversity, as indicated by the fact that, in addition to our involvement with industrial and commercial lighting and power distribution systems, we are actively engaged in highway and bridge illumination, defense-military construction work, space communications and missile projects, marine electrification, the rewinding and repairing of motors, generators and transformers plus numerous activities related to distributorships and general office routines.

And, in *all* of these many business endeavors, we have found that equipment leasing provides an acceptable solution for practical financing.

NEW S-2 TERMINAL BLOCK ASSEMBLY—with exclusive one-piece combination jaw and connector strap—permits an unbroken current path from meter blades to line wires for excellent electrical conductivity, low heat rise, for added reliability.

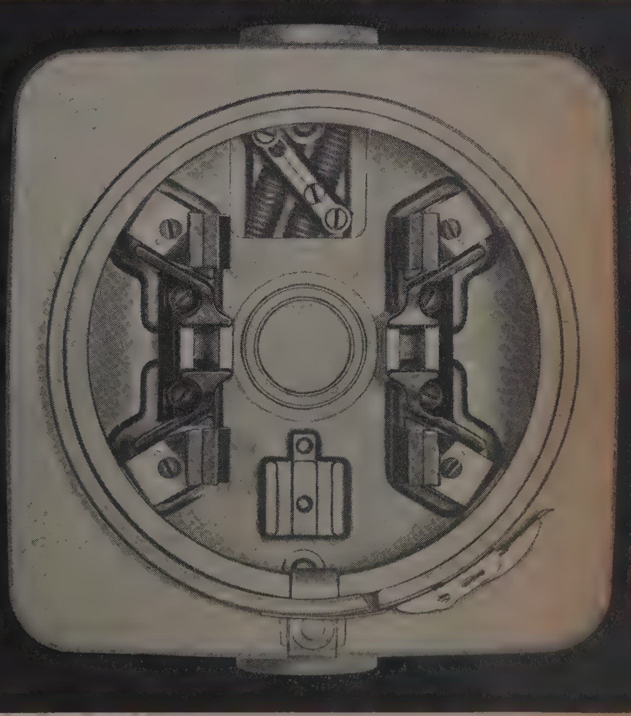
NEW PLUG-IN TERMINAL, another General Electric S-2 exclusive, installs in seconds—without tools, and without removing any part of the meter socket . . . greatly simplifying shop or field conversion to five or six terminal sockets.



EXCLUSIVE SQUARE DIE-CAST ALUMINUM CASE—with baked-on all-weather finish—gives maximum strength, corrosion protection . . . provides full raintight construction . . . unitized hubs. And, modern styling eliminates sharp, hazardous corners.

General Electric Announces . . .

NEW S-2
SQUARE METER SOCKET



General Electric S-2 sockets—for all 100-amp services—offer two exclusive new features providing greater reliability, increased versatility.

GREATER RELIABILITY is provided by unique one-piece combination jaw and connector strap—permitting an unbroken current path from meter blade to line or load wires with minimum heat rise.

INCREASED VERSATILITY results from the only true plug-in terminal on the market today . . . installs in seconds—without tools—for easy conversion to five or six terminal socket.

PLUS 6 EXTRA VALUE FEATURES

1. Largest wiring space of any die-cast socket—144 cubic inches—permits fast, easy wiring.
2. Die-cast aluminum case—plus baked-on finish—protects against corrosion and weather.
3. Lay-in wire connectors accommodate both aluminum and copper wire.
4. Positive one-way knockouts provide a perfect knockout every time . . . eliminate prying or bending.
5. Choice of neutral connectors—two channel or single lay-in neutral connector.
6. Unitized hubs are cast as part of case . . . no extra charge for second hub at bottom.

NOW AVAILABLE. *Contact your G-E Sales Office or Authorized Distributor for full S-2 information. Or, write General Electric Company, Somersworth, N. H.* 711-01

METER DEPARTMENT

GENERAL ELECTRIC

Helicopter Speeds Pole-Line Construction

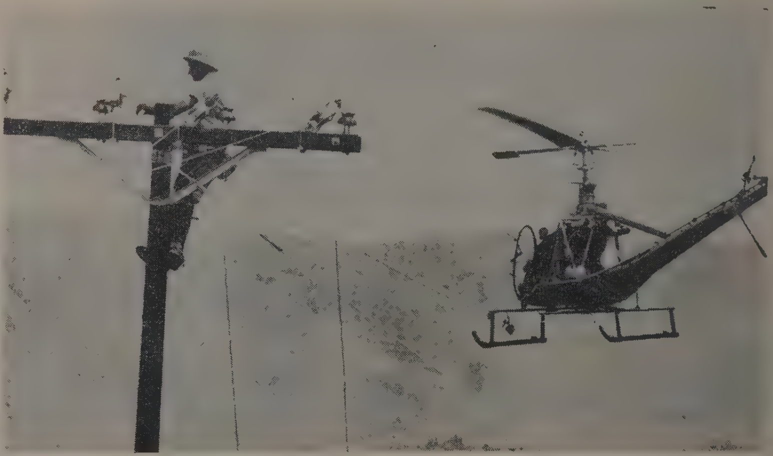
Installation of poles and stringing of conductors for lines in undeveloped country areas are natural chores for the helicopter.

A TWO and one-half mile, 4-conductor power line was recently erected for the Wasco Electric Co-op, The Dallas, Ore., in only six hours and ten minutes by a single light utility helicopter. Contractor in charge of the project was the Wilson Construction Co., Portland, who called on Columbia Helicopters, Inc., also of Portland, for the helicopter service. Scene of the aerial construction job was the hilly Columbia River plateau country near Rufus, Ore., where a sand and gravel plant is going in to supply aggregates for big new John Day Dam, 110 miles east of Portland.

The first stage of the operation called for the helicopter to set 33 poles in predug holes along a right-of-way climbing from sea level to 1,000 ft. Thirty-two of the class 5 and 6 poles were complete with crossarms and insulators and measured 35, 40 and 45 ft, while one 50-footer was carried unequipped. The elapsed flight time by the 305-hp copter varied from two to ten minutes for each pole, and total flight time for this phase was three hours, 54 minutes.

The wire laying took two hours, 56 minutes flight time for the helicopter, which strung two-and-one-half miles of four-conductor line, one wire at a time, for a total of ten miles of wire laid. The line was pulled directly from truck-mounted spools.

According to a Wilson Company spokesman, use of the helicopter resulted in a savings of approximately $2,000.



HELICOPTER pulls line conductors from reels on truck on the ground and lays each over each crossarm where the lineman places the conductors into the pulleys for stringing.

GROUND CREWMAN handles the reels of conductors mounted on racks in an open-top truck and, in general coordinates ground work with work of linemen on poles and the helicopter.

POLE LINEMAN strings conductors through pulleys as they are laid over crossarm by the helicopter.

R&S

ULLETIN 4-B

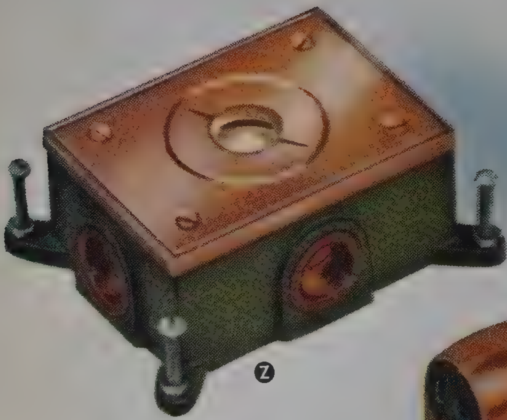
Watertight FLOOR BOXES

SSELL & STOLL COMPANY, INC. 125 BARCLAY STREET - NEW YORK 7, N.Y.

The widest range of quality

FLOOR BOXES, ACCESSORIES and EXTENSION FITTINGS

For every type of building project • • • • • • • • • • • • • • • •



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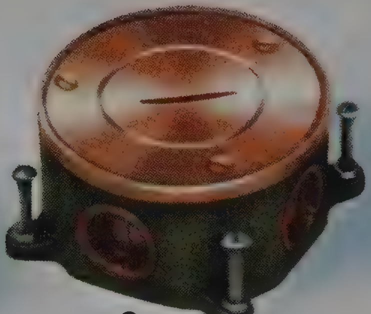

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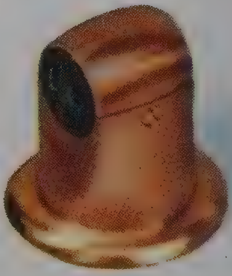

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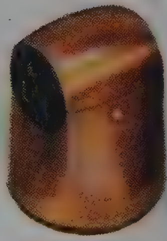

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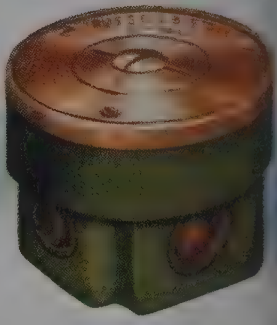

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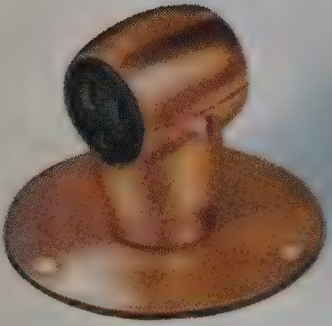

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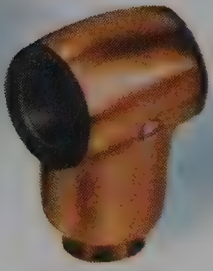

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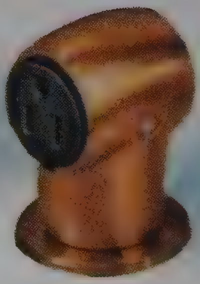

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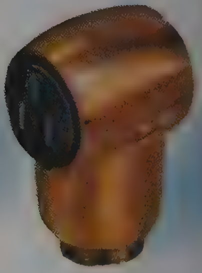

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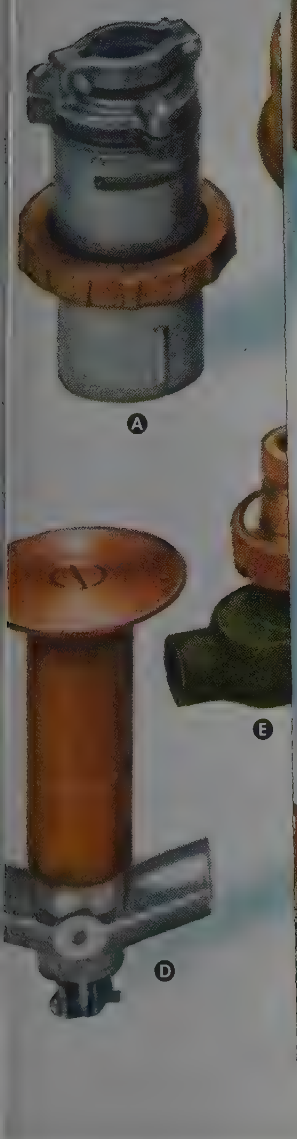
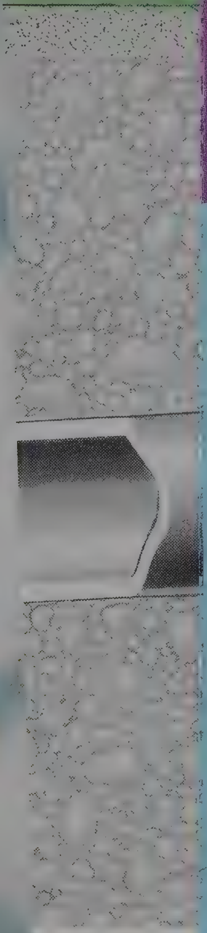
THE FLOOR BOX YOU

LEGEND

Illustration No.	Catalog No.	Illustration No.	Catalog No.	Illustration No.	Catalog No.
A	3328FB	K	155LP	U	3044
B	2547	L	9583	V	3040
C	2512	M	2578	Y	FB20GC
D	AFO-157	N	2519	Z	FB1XC
E	2527-2540	O	2503	AA	3022G
F	2511	P	2644G	BB	3052G
G	2503-H	Q	3000G	BC	Blank Cover Cap.
H	TFO-12	R	2505	CC	3023G
I	2510	S	8059	DD	3058
J	151	T	2580	NK	2519K





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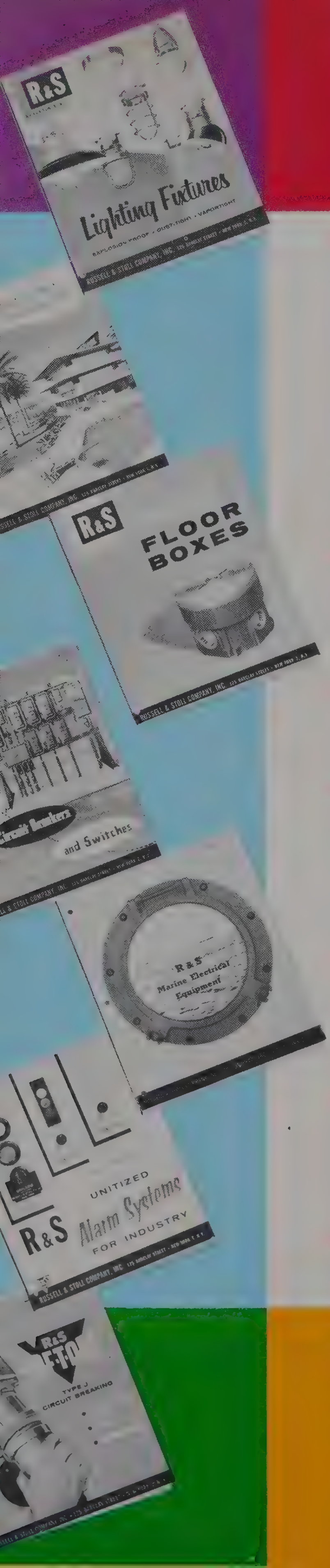


7 NEW ELECTRICAL EQUIPMENT BULLETINS *Now Available...*

Bulletin No. 2-A — R & S LIGHTING FIXTURES BULLETIN

Explosion-Proof — Dust-Tight — Vaportight

- **Explosion-Proof Lighting Fixtures** — with Clear and Prismatic Globes, for hazardous locations, Class I, Groups C and D. Major applications: petroleum and chemical industries, rubber, paint and paint spray rooms — wherever explosive or flammable vapors or gases are present.
- **Dust-Tight Lighting Fixtures** — for Class II Groups E, F and G hazardous locations, such as grain elevators, flour processing, sugar refineries and areas where metal dusts and powders are processed — wherever combustible dusts may be present in the air in quantities sufficient to produce explosive or ignitible mixtures. All types of fixtures are shown, including the new bracket wall types.
- **Vaportight Lighting Fixtures** — pendent junction box and ceiling units, enclosed and gasketed, with and without reflectors; for outdoor lighting use including: airports and terminals, public buildings, docks, ships, platforms — indoors: breweries, dairies, boiler rooms, tunnels, cold storage, and many others in many fields.

Bulletin No. 3-A — R & S ELECTRICAL EQUIPMENT FOR RECREATIONAL AREAS

Features a wide variety of wet and dry niche types of swimming pool fixtures in both front and back relamp constructions, including new units first shown here. Fountain lights, decorative, step and curb lights are included — also, special types of vaportight lighting fixtures and receptacles used throughout recreational fields such as hotels, motels, parks and playgrounds.

Bulletin No. 4-B — WATERTIGHT FLOOR BOX BULLETIN

Preceding pages of this Insert illustrate the R & S complete floor box line. However, the 28 page Bulletin also contains many pages of technical data on individual floor boxes and accessories required by those who specify for specific installations.

Bulletin No. 7-A — R & S CIRCUIT BREAKERS AND SWITCHES BULLETIN

Includes many varieties of R & S Control Units used in the petroleum, chemical and petrochemical fields and by industry in many fields for the following hazardous locations:

Explosion-Proof — Class I, Groups C and D
Dust-Tight — Class II, Groups E, F and G, and Waterproof

Featured product lines include: Circuit Breakers, EFS and EGS Switches, FS and FD Switches, Tumbler Switches, Circuit Breaker and Receptacle Combinations, Disconnect Switches, etc.

Bulletin No. 11-B — R & S MARINE ELECTRICAL EQUIPMENT

Within the 44 pages of this book, you'll find the world's largest line of electrical equipment for shipyards and ships of all types, marinas, etc.

Explosion-Proof Marine Lighting Fixtures and Fittings, Vapor-tight and Waterproof Receptacles, Plugs, Connectors and Switches are featured. Also, a varied line of Water-Proof Lights: Cargo, Bulkhead, Pilot, Fresnel, Gage, Deck Mounting and Berth types.

Bulletin No. U-59 — R & S UNITIZED ALARM SYSTEMS

Fully described are Explosion-Proof, Vaportight and General Purpose Unilarm, Minilarm and Monolarm — panel and surface mounting alarm units for industrial process control and for Graphic and Flow Line Panels.

Ground Detector Unilarm Units are also featured for Hospital Operating Rooms — and the new Industrial Type Ground Detector Unilarm.

Bulletin No. 3157A—R & S SAF-T-ARC CIRCUIT BREAKING RECEPTACLES, PLUGS, CONNECTORS

Weathertight and Waterproof Type J Units in 4 complete lines — 30, 60, 100 and 200 Amperes, 600 Volts A. C., 250 Volts AC or DC.

R & S LITERATURE INCLUDES:

Hundreds of different types of Receptacles, Plugs, Connectors (Ever-Lok, Delayed Action, FS, FD and EFS). Explosion-Proof Pilot Lights, Push Buttons, Switches, Panels and other related items for hazardous locations. Motor Starters and Combinations and other Industrial Controls. Electical Specialties.

FOR ANY OF THE ABOVE BULLETINS, PLEASE REQUEST ON YOUR COMPANY LETTERHEAD. ADDRESS DEPT. 4:

RUSSELL & STOLL COMPANY, INC.
125 Barclay Street • New York 7, N. Y.

Lightweight Bus-Bars Provide Double Saving

According to the Larson-Hogue Electric Construction Co. of Los Angeles, important cost savings resulted when cast-aluminum bus-bars were recently installed at the Aluminum Extrusion Co.'s L. A. plant for the purpose of feeding a 7500-amp anodizing tank. The bus was designed to carry 840A/ sq. in.; connections to the rectifier and tank being made by silver-plating bus-bar ends and then bolting the joints. Splices and right-angle joints were made by the Cadweld process and no unusual problems were encountered.

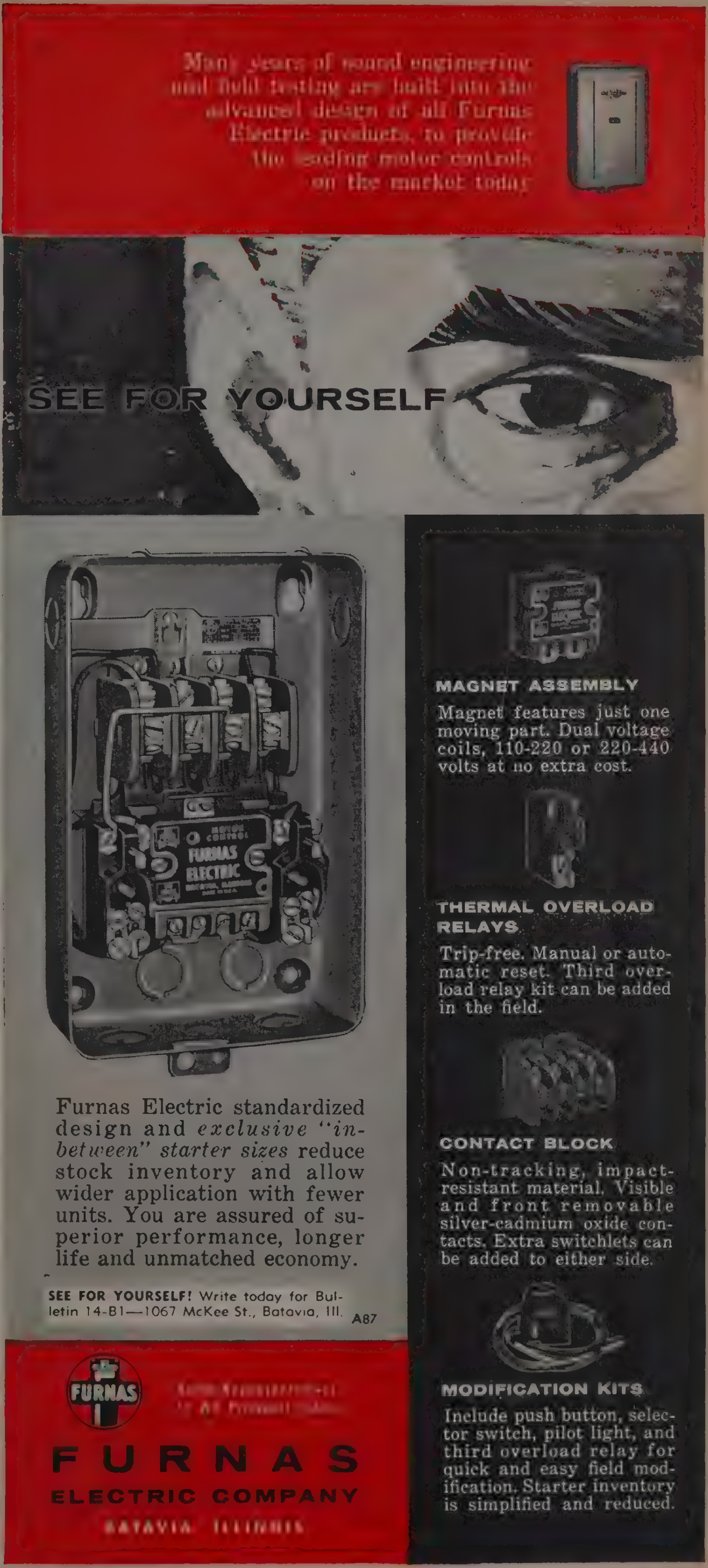
WORKMAN LIFTS 28-ft. long section of lightweight aluminum bus-bar during installation of cast bus for 7500-amp anodizing tank. Connection points between bus-bars, rectifier and tank were silver plated, then bolted.

As stated by Bill Bonzer, Larson-Hogue engineer and assistant superintendent, "The lightweight K-Slab bus was approximately 30% of the cost of copper bus having equivalent current-carrying capacity; and, because of the lighter weight and ease of bending, we discovered that our installation costs on this particular job were about two-thirds the estimated cost had copper been used."

Bus sizes on this job measured ⅜ by 6-in. in cross-section with 20-ft lengths and, since bars weighed only 40 lbs, one worker could easily handle the individual pieces.

Quick Way to Check Circuits with Scope

An industrial-plant maintenance electrician has extended the versatility of the conventional clamp-on ammeter. He used it as a quick way to connect an oscilloscope into a welder ignitron-tube circuit when it was awkward to use a current transformer. The meter, of course,


Many years of sound engineering and field testing are built into the advanced design of all Furnas Electric products, to provide the leading motor controls on the market today

Furnas Electric standardized design and *exclusive "in-between" starter sizes* reduce stock inventory and allow wider application with fewer units. You are assured of superior performance, longer life and unmatched economy.

SEE FOR YOURSELF! Write today for Bulletin 14-B1—1067 McKee St., Batavia, Ill. A87

MAGNET ASSEMBLY

Magnet features just one moving part. Dual voltage coils, 110-220 or 220-440 volts at no extra cost.

THERMAL OVERLOAD RELAYS

Trip-free. Manual or automatic reset. Third overload relay kit can be added in the field.

CONTACT BLOCK

Non-tracking, impact-resistant material. Visible and front removable silver-cadmium oxide contacts. Extra switchlets can be added to either side.

MODIFICATION KITS

Include push button, selector switch, pilot light, and third overload relay for quick and easy field modification. Starter inventory is simplified and reduced.

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FURNAS
ELECTRIC COMPANY
BATAVIA ILLINOIS

had to be of the proper size and rating.

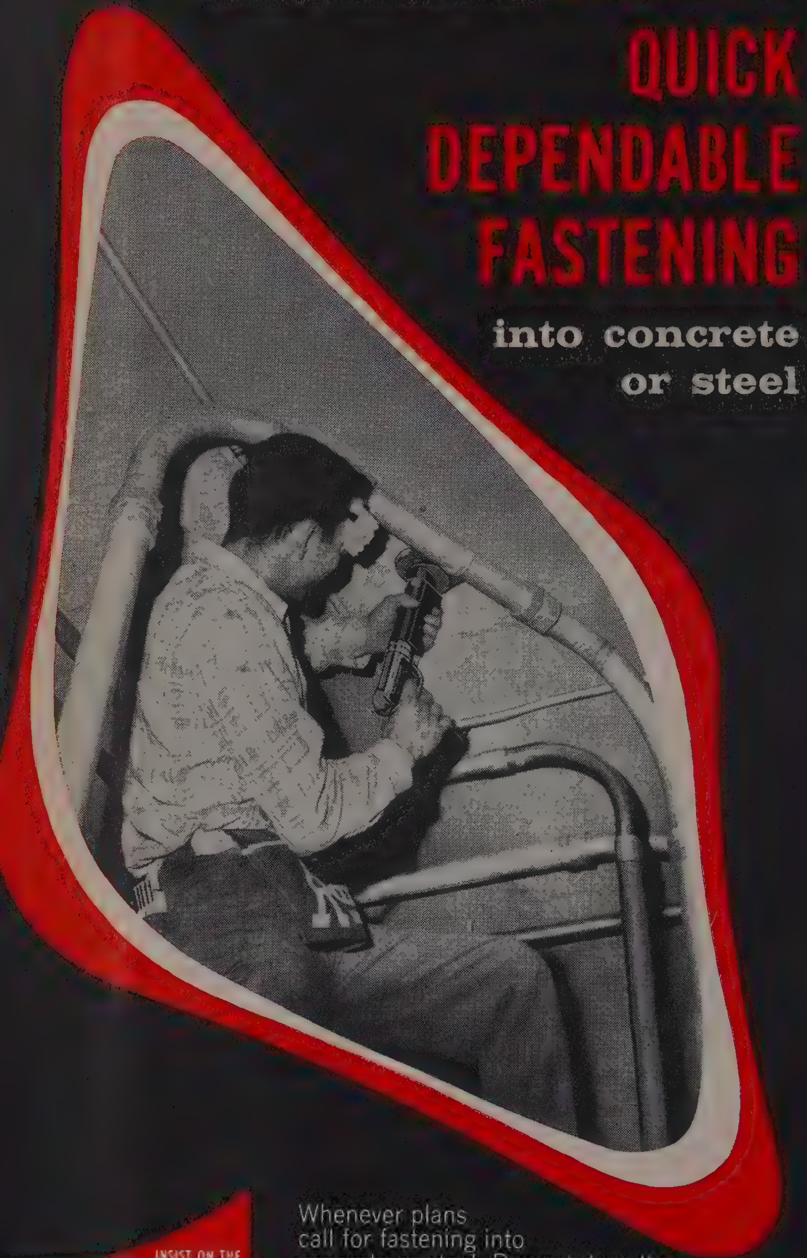
The G. E. meter used for this purpose has a small removable cover which bared the soldered terminals of the instrument transformer. When used with the oscilloscope, this meter cover was replaced with a special one designed with two exterior binding posts, connected to a pair of spring-brass straps on the underside. With the cover in position, these straps made pressure-contact with the instrument-transformer terminals. The two scope leads were then connected to the binding posts.

This special cover was substituted only when the clamp-on meter served as a quick means of checking the tube circuits with an oscilloscope. For conventional applications, the orignal meter cover was used.

Load Growth Demands Higher IC of CBs

Replacement of old electrical protective equipment can be enormously costly, difficult and time-consuming, when loads expand beyond the ratings of existing equipment. The problem is even more complex when there's no room for additional equipment, or when replacement with similar equipment of higher ratings is too costly to consider. Such a problem was solved recently by engineers at the Kodak Park

REVITALIZED SWITCHBOARD incorporates fuse-CB combination units to provide sufficient interrupting capacity to meet the fault current capability of increased transformer kva. Each of these units is mounted on a steel panel and inserted in the place previously occupied by a large air CB (a power CB). The old CBs were made inadequate when the fault current capability of the new transformers exceeded the IC of the old breakers.



Leading contractors use Ramset for

QUICK DEPENDABLE FASTENING

into concrete or steel

INSIST ON THE RED TIP FASTENER WITH THE W TOP

Whenever plans call for fastening into concrete or steel, Ramset does the job in a split-second. Ramset powder-actuated fastening has proved far more efficient and economical than old-fashioned methods. With Ramset you're assured of quick, easy fastening, even under the toughest conditions . . . and every fastener is guaranteed!

Ramset offers an amazing variety of rugged Red Tip fasteners and dependable powder charges . . . just right for every application. This wide selection of fasteners and charges means you pay only for what you need . . . you get lowest in-place fastener cost with Ramset!

Call your Ramset dealer (under "Tools" in Yellow Pages) today, or write direct to find out how Ramset can save you money.

Ramset® Fastening System

OLIN MATHIESON • WINCHESTER-WESTERN DIV. • 285-J WINCHESTER AVE. • NEW HAVEN 4, CONN.

SILICONE NEWS from Dow Corning

Now I'm In Little League

Since We've Converted "Down-time" to "Spare-time" by Specifying Silicones

Three years ago, when Little League baseball was organized in our community, I was interested. Because I'm a family man with three boys, and I'd been a fair ball player, I was asked to manage a team. I wanted to help, but with my job, I knew I wouldn't have the time.

You see, I'm maintenance manager at the local foundry and metal working plant. We have more than 1500 integral horsepower motors. When a motor burns out, it has to be replaced immediately. With the increased frequency of failure in the summer . . . plant temperatures skyrocket . . . my time is not my own.

One day I saw a Dow Corning advertisement about silicone insulated motors. I wrote them and got all the information . . . technical data, too. After studying the material, I suggested to management we run our own life tests by having our problem motors rewound with silicones instead of with Class B insulation, as we were doing.

Result: we now specify silicone insulation in all of our motors exposed to heavy duty cycles, shock loads, frequent start-stop-reverse operation, high ambient temperatures and humidity. Savings are around $5000 a year . . . *not counting the savings in production and maintenance time.*

The sharp reduction in motor maintenance has given me some free time. This summer I managed a Little League team. By the way, my oldest boy looks great at second base, and he's no slouch at the plate.

Say, why don't you write Dow Corning for their literature on silicone insulated motors and transformers? I'm glad I did.

(This fictional story is based on actual plant experience with silicone insulation. Name provided on request.)

For information on
silicone insulated motors,
write Dept. 2810

first in silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D. C.

TRADE **ARRO** MARK

spiral-drive

NAIL ANCHOR

For All Masonry
(RUST PROOFED)

DRILL HOLE
Same diameter as anchor. Depth should be length of anchor less thickness of fixture.

INSERT ANCHOR
Through fixture and tap it into masonry flush against the fixture.

PLACE NAIL
Into anchor and hammer nail until fully inserted.

The fully inserted nail will expand the anchor and fasten the fixture firmly and neatly to the masonry.

13 SIZES AVAILABLE
Diameter and Length from 3/16"x7/8" thru 1/2"x3 1/2"

SILVER KING
SELF DRILLING SHIELD

See your industrial, hardware or electrical supplier

ARRO EXPANSION BOLT COMPANY
DEPARTMENT D, P.O. BOX 388, MARION, OHIO

Works of Eastman Kodak Company, Rochester, N. Y. They applied compact, current-limiting, molded-case circuit breakers to provide, in the space previously used, higher interrupting capacity and far easier maintenance.

The problem was created when installations of larger transformers, needed to carry additional load, had increased possible fault currents far beyond the interrupting capacity of branch circuit breakers which had been installed in 1930. The old breakers were rigidly mounted, large air circuit breakers which had provided 30 years of good service. But the combination of continuous demand for power, higher possible fault currents and rigid mounting—which made servicing extremely difficult—ruled out continued use of the old equipment. And substitution of new, higher-rated breakers of the same type was not practical because of the high costs of equipment no longer manufactured as standard items.

Kodak selected Cordon molded-case circuit breakers, made by I-T-E Circuit Breaker Company, Philadelphia, to replace the old breakers because of their ample continuous and interrupting ratings, small physical size and availability with drawout connectors. Changeover to the new units was easy. The new molded-case breakers, each mounted on a steel plate, interchanged perfectly with the old slate-mounted air breakers. Electrical installation consisted merely of making connections to the existing bus and to outgoing lines. Plug-in mounting of the circuit breaker simplifies maintenance and makes it possible to remove a CB from the switchboard without shutting down other circuits.

The new breakers are designed specifically for use on systems where the available fault current exceeds the interrupting rating of standard breakers. They combine the regular thermal and magnetic actions—which protect against overloads and low-magnitude short or ground faults—with current-limiting fuses for interruption of heavy faults. Short circuit stresses are reduced as a result.

Mercury-Arc Rectifiers Boost DC Supply

Rectified substations have been furnished for several areas of the Gary (Ind.) Steel Works of the United States Steel Corp. to aid in

WITHOUT SEALTITE FLEXIBLE, LIQUID-TIGHT CONDUIT, THE WIRING TO THIS MOTOR COULD BE A TROUBLE SPOT

irt, detergents, vibration—any one of these can cause rious damage to wiring. The motor above is exposed to l three. But because it controls the entire compressed air pply in Carling's modern new brewery in Atlanta, it's too portant to be plagued by wiring troubles.

That's why Carling specified Sealtite here and in many her potential trouble spots. In fact, wherever wiring is posed to dirt, detergents, grime and moisture, it's pro- cted by Sealtite.

Indoors or out, in the roughest weather or even in cor- sive chemical atmospheres, Sealtite offers you the same onomical protection. It's easy to install too. Why not use it to eliminate some of your potential trouble spots? **WHERE TO GET SEALTITE**—Electrical Wholesalers stock Sealtite in easy-to-handle coils, in black or gray. Be certain you ask for and get the quality conduit marked "Sealtite" and "Anaconda" on the cover. Buy it in long lengths on reels or in cartons and cut it on the job without waste. Your wholesaler also stocks liquid-tight connectors.

Free Booklet S-542 gives full information on Sealtite. Write: Anaconda Metal Hose, P. O. Box 791, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. Sealtite is approved by Canadian Standards Association.

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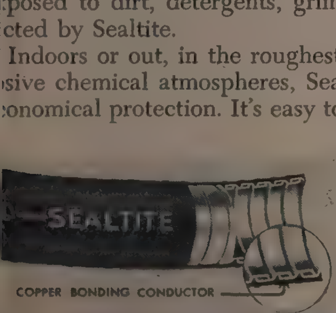

CUTAWAY SECTION of Type U.A. Sealtite shows tough polyvinyl chloride jacket over flexible metal core. Copper conductor wound spirally inside conduit gives positive ground

LISTED UNDER LABEL SERVICE PROGRAM OF UNDERWRITERS' LABORATORIES, INC.

Insist on the conduit marked **SEALTITE**®

flexible, liquid-tight conduit

an **ANACONDA**® product

Hi
TRADE MARK REG.

"Tru-Start" CORE DRILLS

FOR DRILLING LARGE HOLES IN . . .

CONCRETE, BRICK, STONE, SLATE, ETC.,

START EASIER . . CUT FASTER

EASY TO USE STARTER POINT

- NEW inexpensive "STARTER POINT" eliminates walking . . . locates hole accurately and quickly. Cuts drilling cost!
- LARGE MULTIPLE CARBIDE CUTTERS permanently bonded to drill body—guarantee longer tool life.
- THREADS START AT CUTTER EDGE and are continuous . . . assure faster, smoother cutting.
- LANDS AND SPIRAL designed for quick removal of dust—eliminate packing and stalling.

Hi "TRU-START" Core Drills are made of special case-hardened steel, black oxide finish. Standard drill sizes, ½ to 2½". Fully guaranteed!

Hi "TRIPL-FLUTE" PERCUSSION DRILLS

"Hi" Percussion Type Masonry Drills are accurately machined to size from solid bars of the highest grade tool steel. These drills, the most adanced masonry drills available, are used with hand hammer and holder, or chuck and impact hammers (electric or air). Three-fluted type . . . 8 sizes. Easily sharpened.

SEND FOR "HI" FASTENER CATALOG

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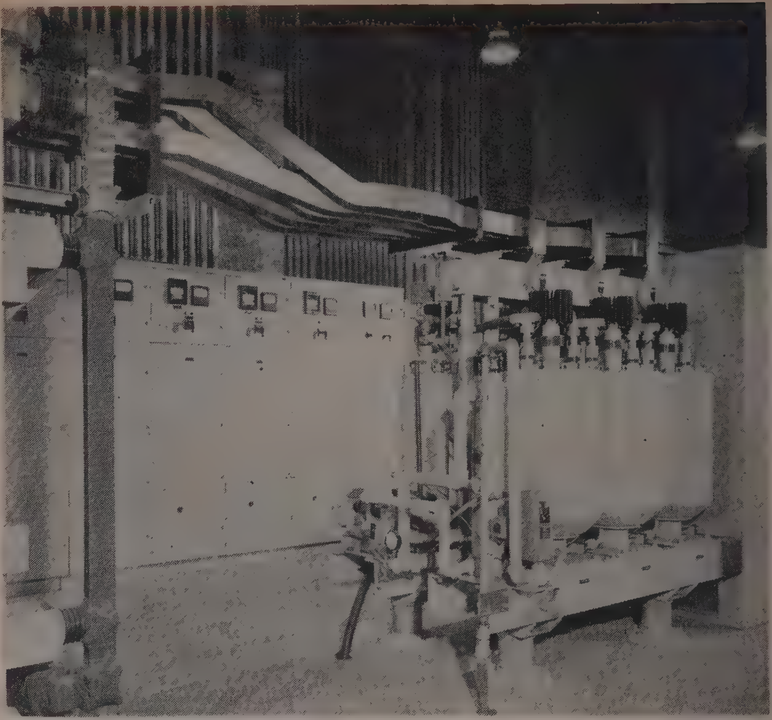
FIRM__________
STREET__________
CITY__________ STATE__________

Hi TRADE MARK REG. HOLUB INDUSTRIES, Inc.
442 ELM ST. • SYCAMORE, ILL.



MERCURY-ARC RECTIFIER substation is shown here connected to rectifier transformer unit. Switchgear lineup is in background.

its modernization and expansion program.

Two 1000-kw Allis-Chalmers subs, with sealed-tube rectifier frames, were installed in the south ore bridge area. Because outdoor space was available, oil-immersed rectifier transformers were used. The high-voltage ac and dc switchgear are each in separate lineups, allowing the greatest utilization of substation space. All of the interconnecting cable work between the outdoor rectifier transformer, the rectifier frame, and the dc switchgear is being furnished as factory pre-assembled duct.

In the billet mill area of the plant, a 1500-kw sub has been installed with pre-assembled lineup. Because of space limitations, an indoor, water-cooled, Chlorextol-immersed rectifier transformer is mounted separately; and the high-voltage ac switchgear is in a remote lineup.

Two additional 750-kw units similar to that at the billet mill were installed in the coke plant. Here, an overhead tie bus duct was used to allow parallel operation between the two rectifier lineups installed face to face with the operating aisle between them.

EXTENSION LADDER equipped with raceway crossarms, 20 500-watt floodlights, outrigger stabilizing base, twist-lock-connected feeder cable and guywire wind bracing provides illumination for country-touring tent show to publicize features of new DC-8 jetliners.

Lightweight Telescopic Tower Is Portable Floodlighting Medium

A 5-kw portable floodlighting system is providing an illuminating impact for United Airline's dramatic presentation of Jetarama—a huge tent show now touring the country to acquaint the air-minded public with features of the new DC-8 jetliners. And, to facilitate transportation from city to city, compact packing and easy assembly, the lighting system consists of lightweight aluminum ladders, stabilizing outriggers, demountable cross arms and series of 500-watt luminaires that are bolted together to form 28-ft-high towers. Five

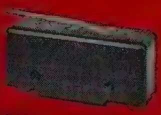
KLIKSWITCH BY GENERAL CONTROLS

Now Available through Authorized Distributors

ational distribution now is available for one of the most complete lines of precision snap action witches built to industry standards. Select all your switch needs from a broad variety of recision engineered switches designed for exceptional repeat accuracy. Local authorized General ontrols distributors provide prompt delivery of KLIKSWITCHES. Factory trained engineers in 4 national branch offices are always ready to give you field assistance.

OLLER PLUNGER

PIN PLUNGER



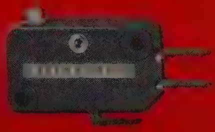
FLEXIBLE LEAF ACTUATOR

ROLLER LEVER ACTUATOR

TYPE S4 BASIC KLIKSWITCHES

Completely self-contained, sealed units are available from a wide selection of models with SPDT, SPST NC, and SPST NO contacts, with or without mounting ears and with a wide selection of actuators including Roller, Lever and Plunger types. S4 KLIKSWITCHES provide ideal reliable service in general purpose and heavy duty applications of all kinds.

COMBINATION QUICK CONNECT AND SOLDER LUG



SHORT SOLDER LUG

SCREW TERMINALS WITH LOCK WASHERS

TYPE S8 BASIC SMALL PRECISION KLIKSWITCHES

High electrical capacities are featured in this top quality postage stamp sized switch. Engineered to meet exacting requirements of small switch specifications, Type S8 KLIKSWITCHES give big performance in a small unit. Flat bases around the mounting holes afford rigid multiple mounting on common mounting screws, rods and separators for multiple cam control of several circuits.

PALM BUTTON ACTUATOR BOTTOM MOUNTING ELASTONER SEAL

PLUNGER ACTUATOR SIDE MOUNTING ELASTONER SEAL

ROLLER ARM SIDE MOUNTING

UNIVERSAL ROLLER PLUNGER SIDE MOUNTING

TYPE S610 ENCLOSED KLIKSWITCHES

Here are small, rugged, reliable snap action switches of tremendous life—ideal for limit, safety, control and industrial applications of all kinds. Cast aluminum housing protects switches and facilitates mounting and wiring. A wide choice of actuators and many optional features are available.

PIC

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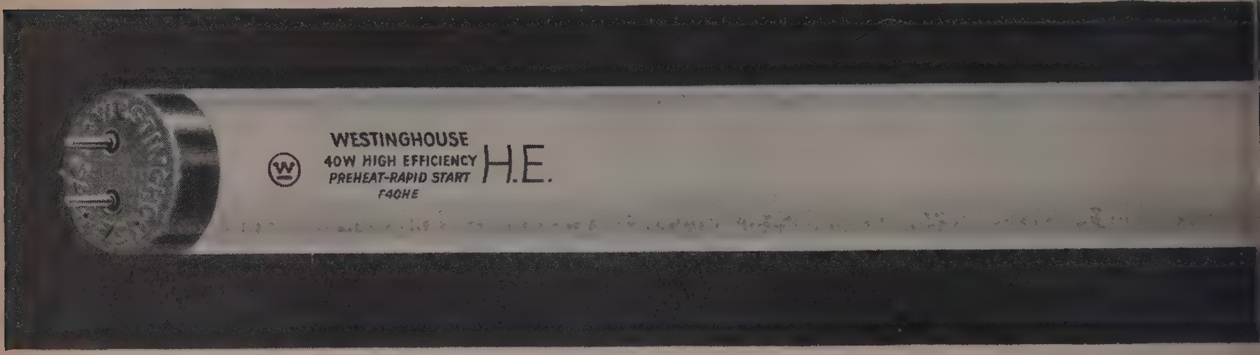

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a brand new fluorescent
more light at

- **36% more light than daylight type**
- **15% more light than cool whites**
- **No extra cost for power**
- **No premium price**
- **Just snap in your present fixtures**

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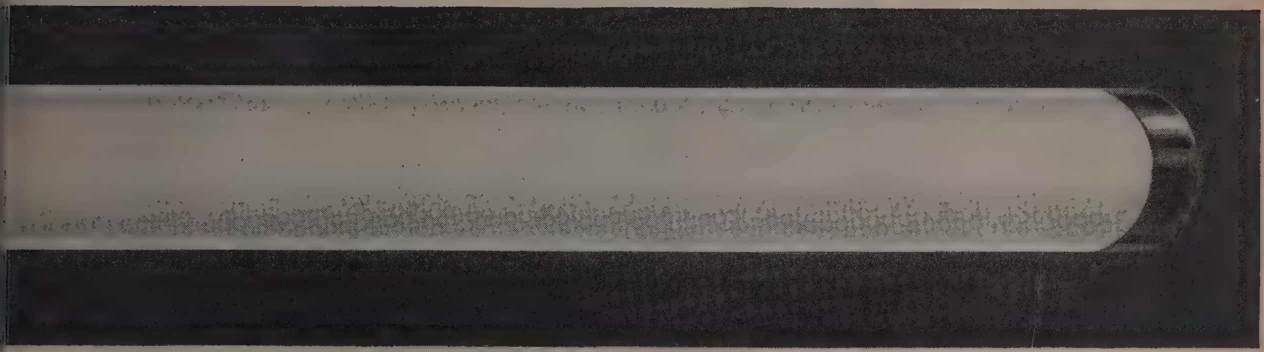
W!



EFFICIENCY Lamp...
lamp which gives
no more cost!

Now you can increase the lighting level in your factory, office, warehouse or store without changing a single fixture, adding to power costs or paying a premium price for the lamps.

New High Efficiency Westinghouse Fluorescent Lamps (40-watt Universal and 96" Slimline types) snap into your present fixtures. They give 15% to 36% more light than the cool white or daylight lamps you are now using.

Try them in an entire work area. If you don't agree that you get more light—softer, more comfortable light—we will exchange them for any Westinghouse Fluorescent Lamp of your choice.

Order new "H.E." lamps today from your authorized Westinghouse Lamp Agent or nearest Westinghouse Lamp Sales Office. You can be sure if it's Westinghouse.

Westinghouse

WESTINGHOUSE LAMP DIVISION
Westinghouse Electric Corporation, Bloomfield, N. J.

a
baker's
dozen
for
profit

11 genuine Wagner Motor Replacement Parts, 1 Wagner Repair Tool, and your workmanship. That's a baker's dozen: 13 good things teamed to build customer confidence and repeat business.

What's more, you'll do a better job when you repair Wagner Motors—and, you'll do it faster and more profitably—with genuine Wagner Motor parts. That's because they *are* genuine . . . exactly like the parts they replace. They fit right, work right . . . always.

Parts available for Wagner Repulsion-Start Induction Motors: sleeve or ball bearings, brushes, brush holders, commutators, and armature assemblies. For Wagner Capacitor-Start Induction Motors: bearings, capacitors, starting switch assemblies, switch sleeves, centrifugal mechanism weights and springs. A special Wagner bearing tool speeds sleeve bearing installation.

Genuine Wagner Motor Parts are profitable to use. They are available through more than 850 Authorized Wagner Service Stations or Parts Distributors across the country.

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OVER 850 AUTHORIZED SERVICE STATIONS OR PARTS DISTRIBUTORS WR60-5
MOTORS • BEARINGS • STANDARD ROTORS • BRUSHES • CAPACITORS • COMMUTATORS

such towers are used to illuminate the exterior of the tents; each tower supporting 20 lights arranged in two equal rows.

Since aluminum tallscopes are used as basic towers, these vertical components can be compacted for travel; extended for service. And, since crossarms are formed from 10-ft raceways, wiring for floodlights can be contained therein. Then, after lighting units are bracketed to towers and connected via twist-lock assemblies to feeder cables, towers are raised and stabilized by means of multiple rubber-shod feet as well as by guy wires attached via turnbuckles to ground-driven steel anchor pegs.

The towers, created by the Holzmueller Corp., lighting contractors of San Francisco, may be completely assembled and erected in a matter of minutes, yet their ready disassembly, compact shipping dimensions and lightweight construction makes them ideal wherever portable floodlighting is required.

Relighting Stadium To 115-FC Level

Last fall, Tiger Stadium at Louisiana State University, Baton Rouge, La., was relighted to modern standards. The new 8-tower system is one of the finest in the nation, providing a uniform lighting intensity of 115 footcandles across the field—which is about five times

BASE CONNECTIONS for each of the 16 poles were made as shown—lowered by crane into position high atop the stadium walls. Base of pole is 22 in. in diameter. The anchor base is 2½ ft on a side. Secondary feeder conductors are shown emerging from flex and running up into pole to supply panels on tower.

THIS EMBLEM ON A FIXTURE BALLAST BRINGS YOU PRACTICAL ADVANTAGES

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CERTIFIED
by
ETL
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Participation in CBM is open to any manufacturer who wishes to qualify

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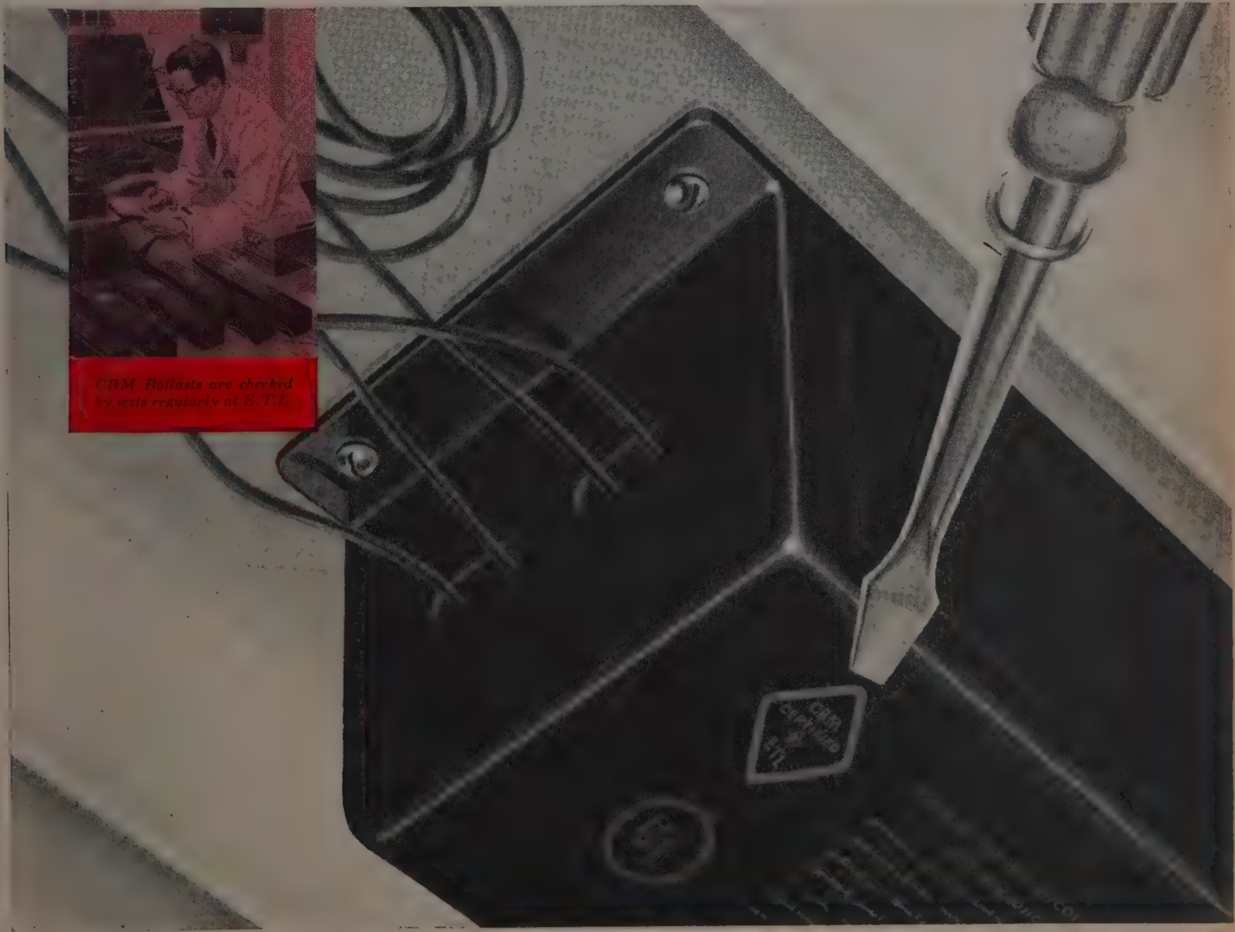

CBM Ballasts are checked by tests regularly at E.T.L

Among them . . . up to 40% more light output and sustained peak light output to give the benefits of today's recommended higher lighting levels. You also get long lamp and ballast life . . . positive starting . . . U. L. listing . . . **in short, performance that meets specified CBM standards** . . . checked and certified by Electrical Testing Laboratories. Enjoy CBM benefits on fixtures that you sell or specify. And to keep pace with CBM progress, ask us to start mailing you "CBM NEWS".

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The Best Way To Install Boxes & Fixtures In Dropped Ceiling Work . . .

Arrow Conduit

CHANNEL SUPPORT

MORE ECONOMICAL!

MORE EFFICIENT!

No more makeshift arrangements! These features are "selling" contractors, everywhere!

- Many slots allow fixture stud to be attached anywhere on support.
- Special design in this support assures maximum strength and rigidity for supporting fixtures.
- Two sizes: 1" wide by ½" deep
  1½" wide by ¾" deep
- Made in 10 ft. lengths. Can be cut in multiples of 6".
- 14 gauge galvanized steel.

Samples and specification sheets on request.

OUTLET BOXES • GANG BOXES • COVERS • BOX SUPPORTS

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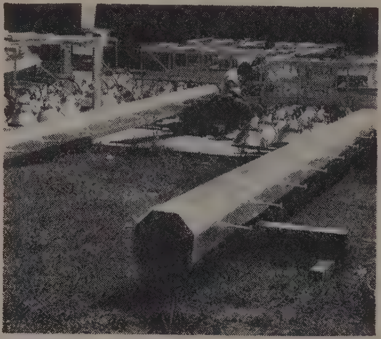
greater than the previous spotty level of 15-30 footcandles.

The old wide-angle floods lighted the playing field, but the level was uneven, causing blind spots which made for very poor playing conditions. And the layout and angle of the flood units caused extreme direct glare to spectators along the sidelines. The new system was designed to overcome these objections.



GROUND ASSEMBLY of top sections of towers consisted of installation and aiming of floodlights, construction of steelwork, and connection and wiring of panel and circuits for lighting units.

ERECTION WORK on top section of each pole was performed by large crane which lifted the completely wired assembly into position to permit carrying of supply conductors down to transformer and the slip-fitting of the top section into the bottom.

The new system consists of 572 floodlamp units, supported by 16 high-tensile steel floodlighting standards—each 90 ft tall and constructed with bases over 2½ ft in diameter to withstand 125-mph winds. The new narrow-beam flood units are mounted 163 ft above the gridiron—47 ft higher than in the old system—and are directed down on the playing field.

Electrical power is supplied to the lighting units at 208Y/120 volts from panelboards mounted on the tower crossarms. There are four panels per tower. The panels on each tower are fed from a 112½-kva transformer mounted on the upper promenade of the stands. Primary lines to the transformers are run from a power house on the premises. The system uses two individual feeder lines from the power house to the stadium to provide increased reliability. Contactor control of the feeders to the towers affords the convenience of push-button control of each tower array.

Construction and installation was by Sachse Electric Company, Baton Rouge. Sachse whipped the height versus weight factor in lifting the big electrical towers high on top of the giant football stadium (68,000 seating capacity) by hoisting the facilities up in two sections using powerful lift cranes. First, the lower half of each high-tension steel pole, 50 ft long, was hoisted in place, then plumbed up. The 40-ft section, with complete assembly of lights already installed on the ground, was then lifted and fitted into slip joints high in the air.

The new system was designed by W. H. Dyer & Associates, electrical engineering consultants, Baton Rouge, La.

COMPLETED JOB shows four of the two-pole towers atop the stadium wall in the background. The single-pole lighting assemblies light the LSU practice field.

FROGMEN CONFER ABOARD A CABLE-LAYING BARGE before installation of Okolite-Okoprene 5 Kv underwater power and Okolene supervisory control cables at Freeport Sulphur's off-shore sulphur mine in the Gulf of Mexico. These armored cables carry power and control circuits for the auxiliary drilling platform, where water is removed from sulphur deposits.

THE CABLE-LAYING BARGE moves past part of the Freeport Sulphur installation, "the world's largest steel island," where Okolite-Okoprene and Okolene-insulated cable were specified by company engineers for critical underwater circuits.

Cable'bility at work

Freeport Sulphur chooses Okonite electrical cables for world's first off-shore sulphur mine

> **Cable'bility** (cā'ble·bil'·i·ty) *new word. Noun.* **1.** Ability to design and manufacture electrical cables that give outstanding performance. **2.** Having long background and wide experience in cable research and application. **3.** Possessing keen understanding of customers' problems. Implies eagerness to serve faithfully and dedication to progress. **Syn.** The Okonite Company.

As in other installations where circuit security is a must, Freeport Sulphur engineers chose Okonite submarine power, communication and control cables for underwater circuits to the auxiliary drilling platform which makes possible continuous production at the company's giant, off-shore sulphur mine—first in the world—in the Gulf of Mexico.

Located 2,000 feet from the main structure, the auxiliary platform has a number of wells which remove the excess water from the deposit. The platform houses giant pumps and mixers for the safe disposal of this water.

Two armored three-conductor Okolite-Okoprene 5 Kv submarine cables and one armored 100-conductor Okolene-insulated cable carry all power, communication and supervisory control circuits to the isolated auxiliary platform, enabling control of all equipment from the main platform. In addition, an unarmored 100-conductor Okolene-insulated cable carries control and communication circuits for the main drilling platform from the control house.

Okonite has a cable, too, for *your* circuits that must not fail. For information on the right cable for the right job, ask your Okonite representative or write for free Bulletin EC-1117, "How To Choose Insulated Cable," to The Okonite Company, Subsidiary of Kennecott Copper Corporation, Passaic, N. J.

7295-A

where there's electrical power . . . there's **OKONITE CABLE**

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why can't everybody build switchboards like this?

The answer is simple: only Federal Pacific has the Rotary Handle QMQB fusible switch units with visible blades . . . with the high-current capacity of a circuit breaker . . . with the 200,000 ampere interrupting capacity of fuses. Some manufacturers still use welded angle frames of 16 or 14 gauge steel plates. Federal Pacific utilizes bolted channel construction of 11 gauge steel for maximum strength and rigidity. What's more, Federal Pacific switchboards are designed on the modular principle: when you need to control more power, you can add units or entire sections — quickly and easily. Look again at the switchboard shown! It looks as new on the outside as it is on the inside—thanks to the Raymond Loewy design—exclusive with Federal Pacific. And if you think all this costs more, you're in for a pleasant experience when you contact your Federal Pacific representative. Write for Bulletin 2100, Dept. FP-7, Federal Pacific Electric Co., Newark 1, N. J.

FEDERAL PACIFIC ELECTRIC COMPANY

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growth through creative energy

SORGEL'S SPECIALIZATION

assures Quiet Quality dry-type transformer performance that's the finest in the industry

Since 1916 the principal products at Sorgel Electric Company have been dry-type transformers. Because of this long-time pioneering, specialization and experienced engineering, Sorgel customers are assured of continuous, more dependable transformer performance.

The Quiet Quality of Sorgel dry-type transformers provide the highest efficiency, which reduces operating costs. Sorgel specialization assures a product that requires little or no maintenance, and a design that's easy, more economical to install.

Imaginative progress has been, and is being, made every day at Sorgel. In all forms of modern electrical distribution the Sorgel product is your best buy in stepping down higher distribution voltage to utilization voltage for institutional, commercial and industrial buildings. Look for the Sorgel mark, and when you find it, you'll know this electrical installation was the first choice of a quality-conscious Consulting Engineer, Plant Engineer, Contractor or End-user who wanted to assure dependable, uninterrupted electrical distribution.

Complete Line for Every Purpose up to 10,000 Kva, up to 15,000 Volts, Including Special Transformers and Saturable Reactors

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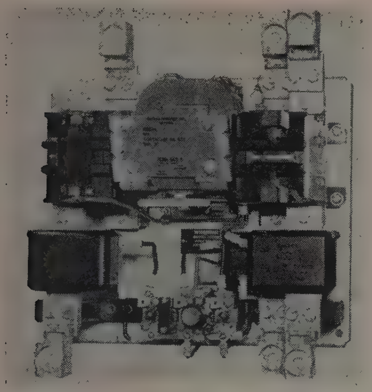
Product News



Starter **(1)**

A new compact Size 5 starter can be mounted in an enclosure 8 in. deep. Dimensions are 13 in. wide, 15 3/16 in. high and 6⅛ in. deep. Parallel double-break contacts provide four contact points to accommodate heavy current surges associated with Size 5 applications. Epoxy-cast current transformers and low current overload relays are used. It features an internal holding-circuit interlock—and up to four additional interlocks can be added in the field. Circuit arrangements available are normally open, normally closed and normally closed late opening. Publication LO-69 is available.

Cutler-Hammer, 228 *N.* 12*th St., Milwaukee, Wis.*

Circuit Breakers **(2)**

A new line of thermal-magnetic circuit breakers which offer overload protection for the entire range of industrial applications with only six frame sizes instead of 12 is now available. Typical of the new frame sizes is the KA breaker (type K, model A) which can now be used instead of the old JK and K frames. The KA frame has an interchangeable trip, will carry up to 225 amps, and will interrupt up to 30,000 amps at 240 volts ac. Width of new 3-pole breaker is 5½ in. and length is 10⅛ in. Frame sizes of new line are designated E, FA, JA, KA, LA and MA. Six frames have maximum current ratings from 10 to 800 amps, and interrupting capacities from 5000 to 50,000 amps. All frames are rated at 600 volts, except for E which is 240 or 277. Breakers have new terminals suitable for either aluminum or copper cable. Listed with UL and conform to NEMA standards.

Westinghouse Electric Corp., P. O. Box 2099, *Pittsburgh* 30, *Pa.*

Pipe Threader **(3)**

A new geared die-stock adaptation for threading up to 4-in. pipe was designed primarily for use with the present No. 552 complete pipe machine, but can be adapted to practically any existing Oster 2-in. machine now in the field. Unit consists of a special tool support which slides on bedways of machine after standard carriage on No. 552 machine is removed. The 4-in. die-stock is supported on two sides of carriage and is driven by a short drive-shaft from chuck of machine.

Oster Mfg. Co., Wickliffe, Ohio

Switch **(4)**

A new "Space Saver" Quiette switch is ⅝ in. deep from face to back and solves wiring problems in thin-wall construction. It is designed to fit 1¼-in. boxes and allow ample space for wiring. Rated at 15 amps, 120-277 volts, ac only, it is available in single-pole, double-pole, 3-way, and 4-way types and can be supplied in Ivorylite or brown Bakelite.

Arrow-Hart & Hegeman Electric Co., 103 *Hawthorn St., Hartford* 6, *Conn.*

Bender **(5)**

No. 777 lightweight segment bender for 1¼-in. through 4-in. aluminum or steel conduit and pipe has been added to this line. It weighs 65 lbs exclusive of shoes. Advanced design of bender makes it possible, with a few optional parts, to do 90° one-shot bending ½ in. through 2 in. and thin-wall bending ¾ in. through 2 in. Bender is powered by a 2-spaced, 10,000 psi hand pump, and can also be operated with a power pump.

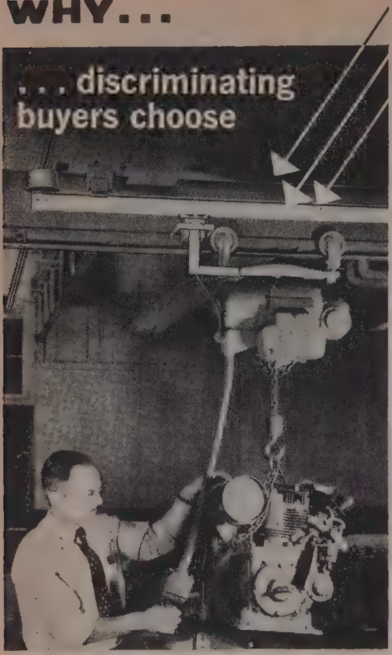
Greenlee Tool Co., Rockford, Ill.

Truck Bodies **(6)**

Unitized welded construction is featured in a new series of utility bodies which have been job-planned to meet the specialized needs of the electrical contractors. The new series includes "Magic Stowaway" features which enable user to change compartment arrangements to meet changing load requirements. All shelves are removable, and are equipped with removable dividers which are adjustable to create material bins of any size in 1 in. multiples. Compartment capacity ranges from 35 cu ft in half-ton models to 68 cu ft in 1-ton units.

Reading Body Works, Inc., Reading, Pa.

GOOD REASONS WHY...



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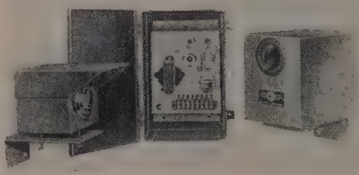
Indicating System (7)

A new "in-and-out" system which keeps track of key office and sales personnel is known as "Indicator." Designed for use in small to medium-sized offices, banks, plants, and in departments of larger organizations, system contains three elements—a 10- or 20-name register, an indicating panel and a low-voltage transformer. Register can be installed near any convenient entrance, while indicating panel is placed atop a reception desk or telephone switchboard. For remote locations, single-name executive registers are also available. Registers, 4½ by 6¼ by 1¼ in., can be either flush or surface mounted. Indicating panels are, 3 by 3¼ in. Operating on 24-volt 60-cycle power, the system meets Class 2 requirements, Article 725, NEC.

Edwards Company, Inc., Norwalk, Conn.



Relays (8)

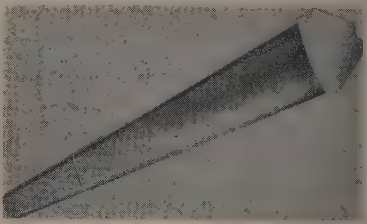
Bulletin 5106-PL and PLJ Pulsolite photoelectric relays are designed to operate under adverse conditions. Relay uses includes: door control, conveyor control, and intrusion alarms. The modulated signal beam cannot be affected by other light sources. Signal beam must be completely broken to operate relay. Relay output is thyratron controlled. Unit combinations are available for operation up to 2000 ft. Relay operates on a modulated light-beam signal. Type PL unit combinations are available for indoor operation at maximum distances of 200, 1000 and 2000 ft, outdoor operation at a maximum range of 100, 500, and 1000 ft. Type PLJ unit combinations are available for indoor operation at maximum distances of 100 ft, and 50-ft maximum distances outdoors.

Clark Controller Co., 1146 E. 152d St., Cleveland 10, Ohio

Oil Cutouts (9)

Two new oil cutouts, with applications for load switching and overcurrent protection have been announced. A 15-kv oil cutout, rated 200 amps, has a 7000-amp interrupting capability. The 7.8-kv cutout, rated 200 amps, has a 5000-amp interrupting capability. Gang-operated mechanisms provide for simultaneous switching for single- or 3-phase circuits. Oil cutouts provide fault-current interrupting and load switching in hazardous locations, or where severe atmospheric conditions are a factor.

General Electric Co., Schenectady 5, N. Y.



Luminaire (10)

The new "VeeLens" series fluorescent luminaire directs light on corridor walls, and controls lengthwise brightness for visual comfort. Unit features a convex reflector and a clear prismatic diffuser. Luminaires may be surface or pendant mounted, individually or in continuous rows. Two sizes are available: 4-ft luminaire for one 48-in. 430-ma rapid-start lamp, and 8-ft for two 48-in. lamps, tandem. Diffusers hinge from either side. Bulletin is available.

Lighting Products Inc., Highland Park, Ill.

Heating Elements (11)

A complete line of electric heating elements has been announced. The full line includes these generic classes of heaters: immersion, cartridge, strip, tubular and switch heaters. Brochure No. 500 is available.

Heatrex, Incorporated, 1274 South Main St., Meadville, Pa.

AMPROBE SWAPS YOU

8 FOR 1

8 REASONS WHY YOU SHOULD USE AN AMPROBE RS-3

FLEXIBILITY. A combination *volt-amp-ohmmeter,* this snap-around instrument provides 3-voltage, 5-current and 1-ohm ranges for true flexibility.

ROTARY SCALE. Only one range visible at one time to speed readings, minimize errors.

MAGNIFYING UNBREAKABLE WINDOW. Read from any angle—even in poor light.

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ADVANCED ENGINEERING. Unique printed circuitry for rugged reliability; exclusive meter movement includes self-shielding internal core magnet.

PRECISE TIME-SAVER. Take readings accurate within ±3% of full scale—in a snap!

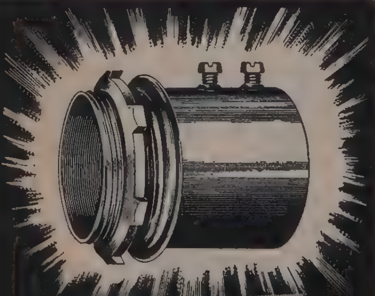
YOUR ANSWERS ARE IN THE BAG. The KIT holds an RS-3, a DECA-TRAN (extends amps readings 10x; to 1200 amps), an ENERGIZER (multiplies *sensitivity* 10x for small-appliance and fractional-h.p. motor readings), test leads and a compartment for your hand tools. **Price** (without trade) : **$84.50.**

ONE REASON WHY YOU SHOULD TRADE TODAY FOR THE TEST-MASTER KIT

Now you can trade in your old snap-around tester. (any make but the AMPROBE JR.) for the compact TEST-MASTER KIT or a new AMPROBE RS-3. No matter how old your present instrument is, or its condition, it's worth real money! Ask your Distributor.

PYRAMID INSTRUMENT CORPORATION, LYNBROOK, NEW YORK *World's Largest Manufacturer of Snap-Around Test Instruments*

"EASY ASSEMBLY... that's why I like E.T.P Fittings!"



E·T·P exclusive pre-set staked screw with deep slotted head makes working easy—even in the tightest areas. There is no backing out when inserting conduit.

CONCRETE TIGHT! One piece, solid tubular steel—cannot open or spread. Available in all sizes from ½" to 2".

Connect with ETP for Economy

Samples and Brochure on Request.

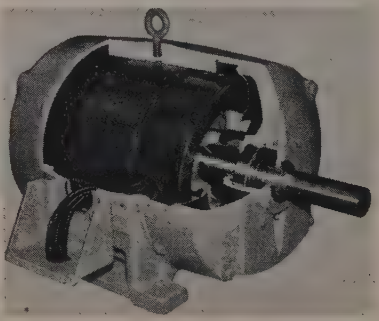
ETP

ELECTRIC TUBE PRODUCTS
74-16 Grand Ave., Maspeth (N.Y.C.) N.Y.
DEfender 5-8000

Converter **(12)**

A new multi-motor power converter designated type MM. It permits the operation of 3-phase electrical equipment from single-phase lines, but with the additional feature of opening operation to any number of 3-phase motors through a single conversion system. Three-phase motors can be operated singly or simultaneously. The multi-motor will produce 100% rated hp for all motors connected to the unit. Multi-motor transformer stations are available in sizes from 1 to 80 hp. Panel controls feature separate hp ratings to match each 3-phase motor in the system. Multi-motor will operate 220- or 440-volt 3-phase equipment from 220-single phase lines.

Add-A-Phase, Div. of System Analyzer Corp., Nokomis, Ill.



Motors **(13)**

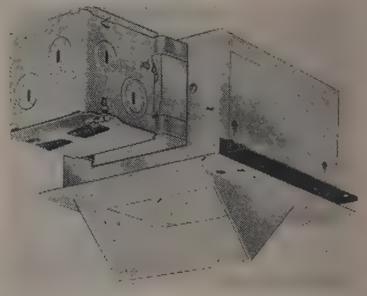
A new line of "Howellsealed" encapsulated motors, 3- or 2-phase, 1 through 125 hp ac squirrel cage, has been developed. "Howellseal," is a specially developed epoxy compound, applied under vacuum to surround each wire in slots and at coil ends to produce a solid mass. Motors are available in NEMA designs A, B, C and D for 1-, 2-, 3- or 4-speed constant or variable torque operation, all standard voltages and frequencies. Bulletin 1005 (E, F) is available.

Howell Electric Motors Co., Howell, Mich.

Wire Connector **(14)**

A new pressure-type connector is for common connection of two, three, or four No. 14 AWG or No. 12 AWG solid conductors. It is UL-listed. Unit measures 1 5/16 in. by ½ in. To use, wire is stripped to width of connector and inserted as far as it will go. A strip gauge is molded into each device. Originally designed for use with Plugmold multi-outlet system, the unit will handle any splice. It is designated the W-30 wire connector.

The Wiremold Company, Hartford, Conn.



Lighting Unit **(15)**

A new 40° recessed "wall washer" unit is for specialized lighting applications. The open frame incandescent fixture is designed for use in homes, offices, motel and hotel lobbies or stores. The one-piece frame size is 7½ in. sq with a finish opening size of 6¾ in. sq. Housing size is 6⅝ in. by 10¾ in. by 4 in. A 60-watt bulb is recommended. Complete prewired unit comes in standard matte white baked-enamel finish with aluminum finish available.

Prescolite Manufacturing Corp., 2229 *Fourth St., Berkeley, Calif.*

Drill **(16)**

A new diamond drilling stand, Model 4110 Vac-U-Rig, is capable of drilling holes up to 8 in. dia. A vacuum pump develops 3,000 lbs holding force within two 13 in. suction discs, enabling stand to be mounted in either horizontal or vertical positions. Complete with a 2-hp Milwaukee-built motor, the Vac-U-Rig weighs 125 lbs and can be rolled from job to job. Other features include an ammeter; a bubble level, a shear pin; a built-in water swivel. Bulletin DD-2 is available.

Milwaukee Electric Tool Corp., 5316 *West State St., Milwaukee* 8, *Wis.*

TO

"FASTEN ONTO SOMETHING GOOD"

(OR TO DRILL IT OR CUT IT)

KNOW THE MAN WHO CAN SHOW YOU HOW

Specifically, for multiple fastening in building and construction with metals of all kinds . . . and for fastening to, drilling or cutting concrete, it pays to know the man from OMARK.

He not only offers you a variety of systems for doing such work. He also brings you experienced on-the-job counsel, and an engineering service to help you specify exactly the right equipment for doing the job, rapidly, dependably and economically.

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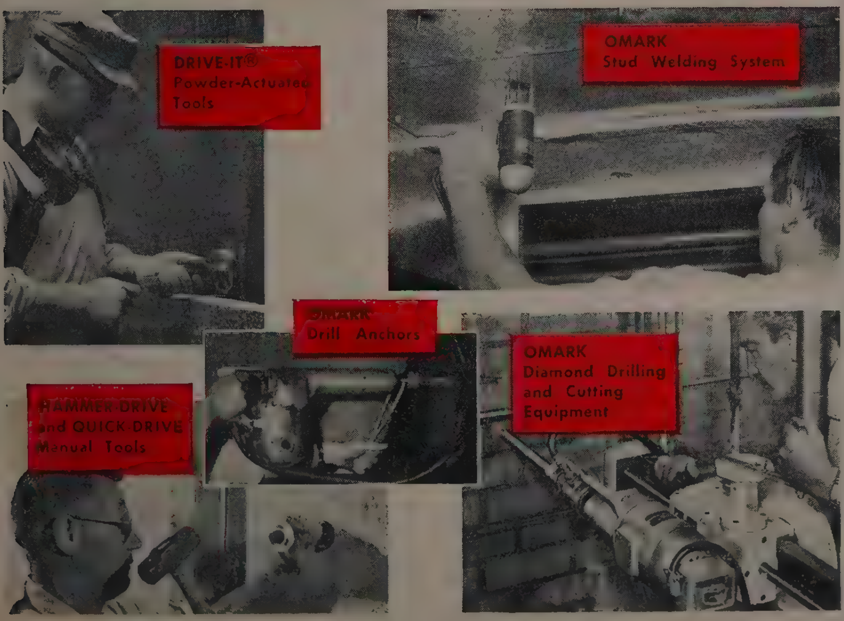
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New Era in Outdoor Lighting . . .

Regal-Lite

The High-powered Low-cost Fluorescent . . .

New elegance in lighting for
RESIDENTIAL AREAS
HOMES • PATIOS • SCHOOLS
PARKS • PLAYGROUNDS

Brighter Light
Lower Operating Cost
Maintenance Free

Regal-Lite can be **serviced from the ground.** Exclusive hinged base permits pole to be lowered to ground and lamps changed in less than five minutes—**by one workman with one wrench!**

For complete information about the modern, low-cost illumination of Regal-Lite write:

STERNER INDUSTRIES, Inc.
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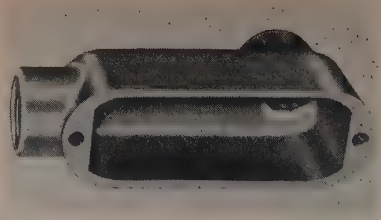
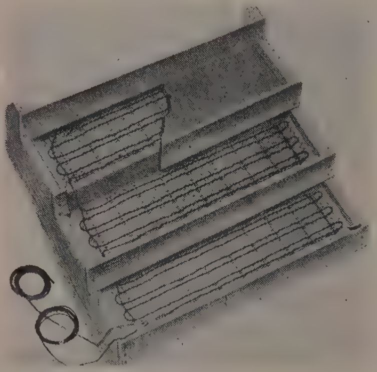


Fittings (17)

New die-cast fittings, augmenting cadmium-plated ferrous-alloy Pylets, are made available in both copper-free and copper-bearing aluminum. Series OR, specification grade, copper-free aluminum Pylets and blank covers have protection of PEC-9 Epoxy coating, applied after Iridite treatment. Cover screws are of stainless steel. Series N, standard grade, copper-bearing aluminum Pylets and blank covers, for normal applications, have an Alkyd-Melamine finish. Bulletins 657 and 658 are available.

Pyle National Company, Chicago 51, *Ill.*



Heater Mats (18)

New electric concrete-step heater mats designed to clear snow and ice from concrete steps. Heaters are Thermwire heating cable interwoven with light-weight galvanized mesh. They are offered in 2-step and 3-step units, heating a section 8 in. wide by 36 in. long on each step. Any combination may be used to match number of steps requiring protection. They have a rating of 42 watts per square ft. Each heater unit contains a 10-ft lead wire and 10-ft ground wire. All cable sections are sheathed in polyvinyl with a nylon coating. Heater units are positioned on top of freshly poured first layer of concrete, then covered with 1 to 1¼ in. top layer of concrete.

Edwin L. Wiegand Company, 7500 *Thomas Blvd., Pittsburgh* 8, *Pa.*

Transmission System (19)

An electrical transmission system employing insulated conductors and plastic spacers, designated Spanway, consists of one to 3-phase conductors, messenger and Spanway spacers, and is capable of carrying conductors up to 400 MCM and voltages up to and including 15 kv. Conductors are hard-drawn stranded aluminum, covered with weather-resistant black polyethylene. Spacers, molded of an acrylic plastic with high resistance to weathering and tracking, hold phase conductors in a 6-in. triangular configuration supported from messenger. Each spacer also acts as an insulator and so reduces the conductor covering thickness necessary to prevent voltage breakdown. Single size, approximately 7¾ in. by 13 in., may be used for 5 kv to 15 kv installations.

Anaconda Wire & Cable Co., 25 *Broadway, New York* 4, *N. Y.*

Fittings (20)

A new line of fittings for all interlocked armor cable, Series 800, support, ground, mount, and dead end the cable. They are available in four basic pipe sizes covering the entire range of interlocked armor cable sizes. Eight different fittings are available in each size for various applications. High strength aluminum is used for all parts.

G&W Electric Specialty Co., 3500 *West* 127*th St., Blue Island, Ill.*

Lighting Units (21)

The new Midee-Ray series of lighting units, with ballast mounted in channel, has been engineered to illuminate dark areas where space is limited. Units, finished in chromium, are offered in three models, 8-watt, 12¾ in. long; 15-watt, 18½ in. long; and 2-lamp 15-watt, 36¾ in. long.

Duray Fluorescent Manufacturing Co., 3318 *W. Montrose Ave., Chicago* 18, *Ill.*

LIPKNOT CW TAPE
TRIPS AND STICKS
T 20° BELOW

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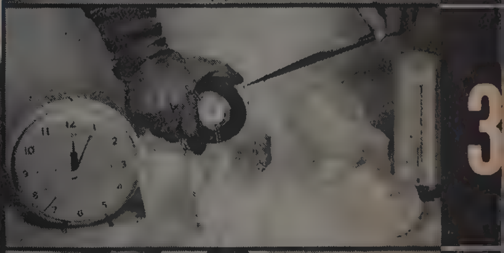

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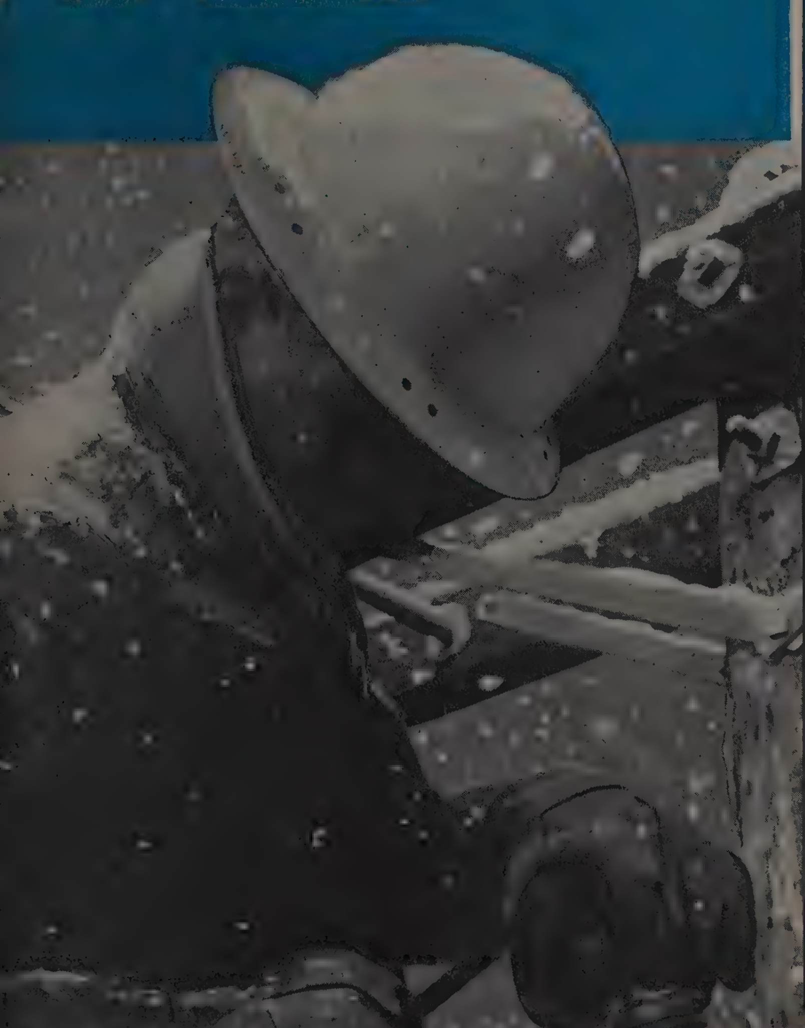

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At 20°F below zero, this remarkable vinyl tape —

- Strips easily from the roll . . .
- Remains completely flexible . . .
- Sticks down instantly — molds perfectly — holds permanently!

Try it in your home freezer — write for a sample roll on your letterhead today!

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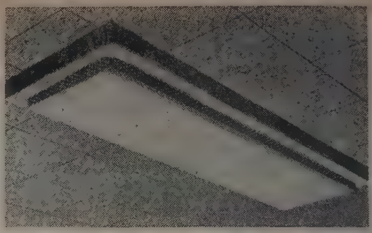
Cost Saving!
Space Saving!
UNIFIED
DIESEL
GENERATOR
CONTROLS

Including
- ✓ Trans-O-Matic Transfer Switch
- ✓ Generator Control
- ✓ Engine Start
- ✓ Battery Charger

in a NEMA Type 1 51" x 34" x 11" cabinet with hinged access door.

Lake Shore now offers its well-known control line combined into one simplified control center. In addition to saving space, you can also save up to 20% of cost of individual controls. **State generator rating when requesting details!**

THE LakeShore ELECTRIC CORPORATION
205 Willis Street / Bedford, Ohio



Luminaires (22)

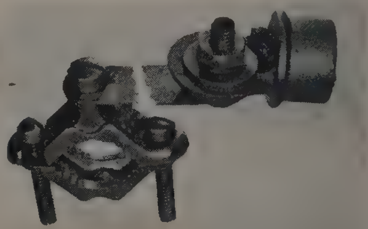
Surface-mounted luminaires with perforated-steel door frames designed to hold either glass lenses or aluminum louvers, will be supplied with type-SF fluorescent luminaires. Luminaires accommodate two, three or four lamps having lengths of 4 or 8 ft and ratings of 40 or 75 watts per lamp. Fixtures can be mounted either as individual units or adjacent to each other for continuous lines of light. Luminaires are best suited to low-ceiling applications.

Westinghouse Electric Corp., P. O. Box 2099, *Pittsburgh* 30, *Pa.*

Non-Interchangeable CB (23)

A new non-interchangeable feature now available on all Square D circuit breakers, load centers and panelboards meets all requirements of Paragraph 240-25G of the 1959 NEC. No modifications are necessary for 15- and 20-amp breakers. Where higher-rated breakers are required, authorized personnel can make modifications to the interior rejection rails. The entire system is visible for ease of inspection.

Square D Company, Mercer Road, Lexington, Ky.



Fitting (24)

A new-type ground-strap fitting which speeds up installation and insures a positive ground, has been developed. The flexible-strap-type clamp facilitates installation when joining conduit to grounding devices. Only one connection for both wire and strap is required with this new ground clamp. Non-corrosive, bronze alloy allows user maximum conductance.

H. B. Sherman Mfg. Co., 22 *Barney St., Battle Creek, Mich.*

Hard galvanized finish for durability; polished satin lustre for lasting good looks.

Even EMT can look good ...if it's CIRTUBE* EMT

TRUE, the first things you look for in EMT are: one, is it easy to work with—two, is it made to give lasting protection. CIRTUBE EMT, by the way, rates tops on both. But there's no reason why EMT can't *look* good as well!

That's where CIRTUBE EMT "shines," too. Reason for its pleasing polished satin lustre is the cyanide zinc plating process Circle uses (even though it costs a little more to apply than other methods).

The zinc bond is better, too—won't chip or flake off. That's because Circle employs elaborate cleaning processes to make sure that the steel is absolutely clean before plating.

Quality finish is only one of many reasons why CIRTUBE EMT has gained such wide acceptance in so short a time. Why not try it next time you order—you'll like it.

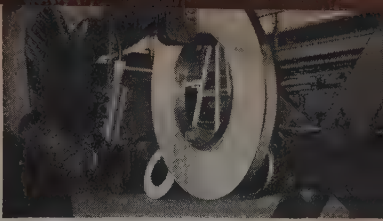
*Trade Mark

CWC CIRCLE WIRE & CABLE
a subsidiary of
CERRO DE PASCO CORPORATION

PLANTS: Maspeth and Hicksville, N. Y. **SALES OFFICES & WAREHOUSES:** In all principal cities

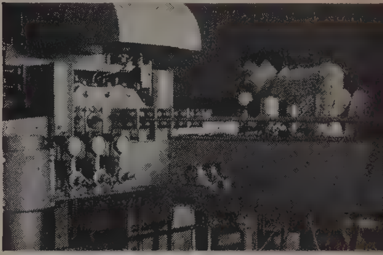
RUBBER COVERED WIRES & CABLES • VARNISHED CAMBRIC CABLES • PLASTIC INSULATED CABLES
NEOPRENE SHEATHED CABLES • "CIRTUBE" EMT

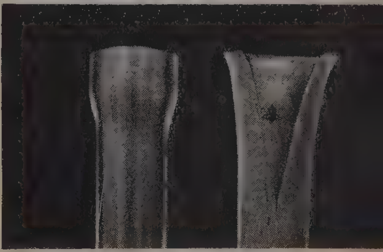
C I R T U B E EMT *Ask for it!*



Proper steel plus! The best cold rolled steel plus the right handling give CIRTUBE EMT its natural bendability.

Easy fishing! A baked-on protective coating gives CIRTUBE EMT a built in lubrication for easier wire pulling.



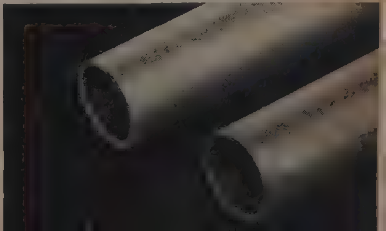


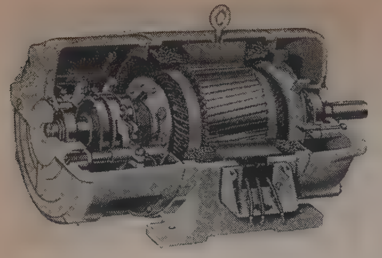
Split-free, bead-free! Induction welded CIRTUBE EMT, left, proves stronger than ordinary EMT, provides easier fishing.

Automated quality control! Automatic controls assure complete and continuing uniform quality of product.

Tight, easily handled bundles! Bright, orange tapes hold CIRTUBE EMT securely for easy handling on and off the job.

Lifetime exterior finish! Hard galvanized finish for durability; polished satin lustre for lasting good looks.

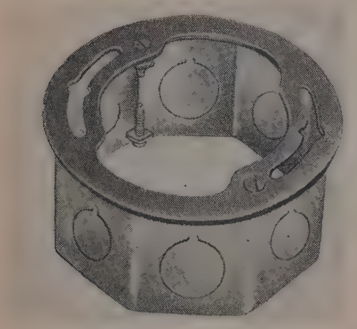




Motors (25)

A new line of completely redesigned wound-rotor motors to meet NEMA standards in frame sizes 213 to 326 U. Rotor is precision wound and has both ends dynamically balanced. Rotor and coils are banded with an epoxy fiberglas. Other features include: improved secondary characteristics; low rotor-inertia design; rugged collector and brush assemblies; plus an advance Class B insulation system for protection against moisture. They can be furnished with open, drip-proof or totally enclosed, non-ventilated enclosures for horizontal, ceiling or sidewall mounting.

Louis Allis Co., 427 E. Stewart St., Milwaukee 1, Wis.



Extension Ring (26)

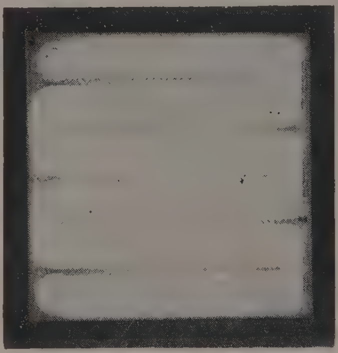
Adjustable extension ring is suitable for alteration work in older buildings where new ceilings are to be installed and in new buildings where plans have been changed. A special slot arrangement allows ring to be turned in either direction, to line up knockouts with incoming conduit. It is designed for easy coupling with already installed ceiling box. Rings are available in standard depths of 1½ in. and 2 in. They are supplied with a combination of ½-in. and ¾-in. knockouts. Also available with all ½-in. or all ¾-in. knockouts. They will fit all standard 4-in. octagon boxes and concrete rings. Catalog sheet is available.

Arrow Conduit & Fittings Corp., 108-20 180*th St., Jamaica* 33, *N.Y.*

Transformer (27)

A new pad-mounted transformer designed especially for commercial suburban areas with heavy low voltage load concentration, is suitable for use in shopping centers, hotels, drive-in theatres, schools, motels, etc. High voltage and low voltage dry-type enclosures accommodate either cable or bus work. They are available in 3-phase sizes, 225 through 1500 kva with high voltage 2400 through 13,800 (no taps) and with a low voltage of 208Y/120 or 480Y/277.

Allis-Chalmers Manufacturing Co., Milwaukee 1, *Wis.*



Fluorescent Lamp (28)

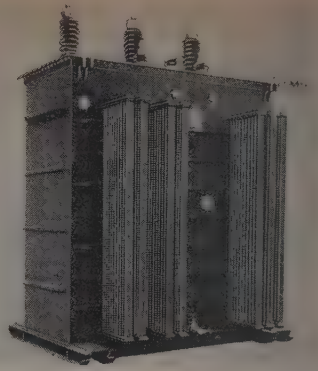
New white fluorescent lamp provides 15% more light than standard 40-watt cool-white lamps and 36% more than daylight-type lamps, as the result of a new phosphor combination. It produces 3200 lumens. Special green phosphors provide high efficiency in lamps. New color produces a cool comfortable atmosphere. Made in universal preheat rapid-start design, the 40-watt high-efficiency fluorescent lamp fits all present fixtures and ballasts. Also available in a 96-in. slimline design.

Westinghouse Electric Corp., Pittsburgh 30, *Pa.*

Grounding Devices (29)

New 5800 Series of 20-amp grounding devices designed to meet heavy-duty requirements of modern equipment, appliances and portable tools. Line includes single and duplex receptacles, also available with round covers, and a U-ground cap. Receptacles will accept all caps, including all 3-wire U-ground, 15-amp 125 volts, and standard 15-amp 125 volts, parallel-bladed caps, so that there is no need for different types of outlets.

Leviton Manufacturing Co., Inc., Brooklyn 22, *N. Y.*



Transformer (30)

Addition to the intermediate section of the oil-immersed line is designated as TLS-HD and covers from 3000 kva to 7500 kva. These units are primarily designed for heavy-duty industrial application under severe operating conditions. The 3750-kva oil-immersed transformer has a primary voltage of 67,000 and a secondary voltage of 7200. New Dura-lec insulation offers the added protection of Class F thermal levels.

Marcus Transformer Co., Rahway, N. J.

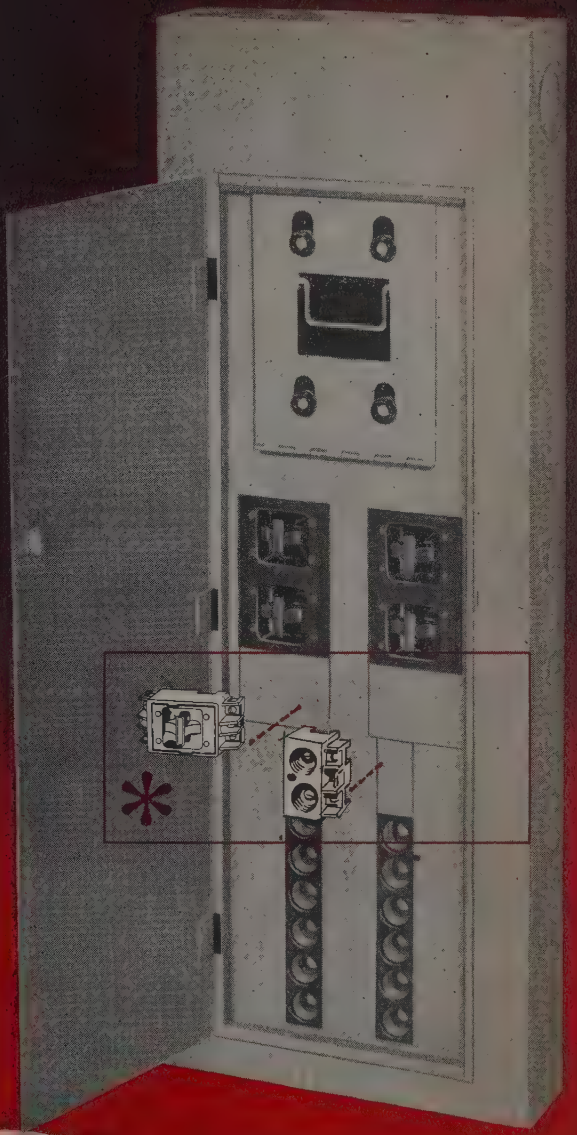
Scaffold (31)

New Hi-Lift extension scaffold extends from 6 ft 10 in. to a height of 26 ft, hand or electrically operated. It is for every type of overhead maintenance such as relamping, cleaning, etc. Roller-bearing swivel casters on all four legs for maneuverability in tight places.

Atlas Industrial Corp., 849-39*th Street, Brooklyn* 32, *N. Y.*

NEW!
200-AMP ADD-ON* SERVICE Equipment

HINGED MAIN PULLOUT!



ARROW AH HART

FLEXIBLE and VERSATILE... All 200-amp "Add-On" pullout and branch circuit units are interchangeable with A-H 100-amp "Add-On" units. Now you meet any customer's 200 amp electrical needs—present *or* future—with just one unit. This unit comes factory-assembled with a main 200-amp pullout, four 30- or 60-amp pullouts and twelve fused branch circuits . . . and you can add 1 or 2 pullouts and 2 or 4 branch circuits at any time with a maximum of 6 pullouts and 16 branch circuits. Exclusive hinged main pullout for convenience.

COMPACT ENCLOSURES... smaller than other comparable units, save space and make faster installations. The 14⅜″ width allows mounting between studs.

FAST, EASY INSTALLATION... is insured by extra wiring space throughout the enclosure . . . including full 5″ head space for incoming service lines. Ample knockouts are located adjacent to the branch circuits. Neutral terminal bars will accept wire sizes 4 to 14.

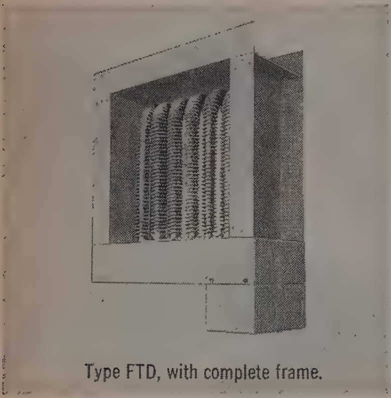
GET ALL THE FACTS. Write today for complete information. Department ECM, The Arrow-Hart & Hegeman Electric Company, 103 Hawthorn St. Hartford 6, Conn.

ARROW AH HART

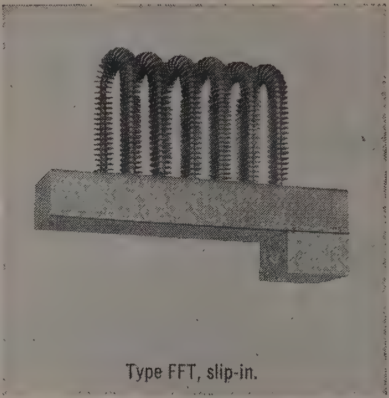
Quality since 1890

ENCLOSED SWITCHES • WIRING DEVICES
MOTOR CONTROLS • APPLIANCE SWITCHES

new!

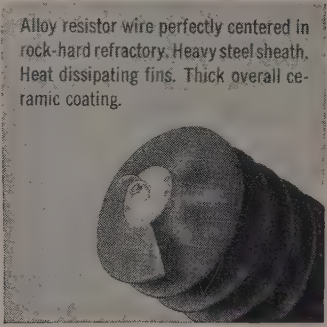


Type FTD, with complete frame.



Type FFT, slip-in.

CHROMALOX ELECTRIC FINTUBE AIRDUCT HEATERS

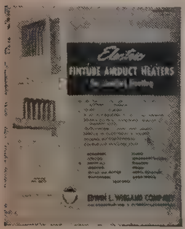


Alloy resistor wire perfectly centered in rock-hard refractory. Heavy steel sheath. Heat dissipating fins. Thick overall ceramic coating.

...for use in central heating and air-conditioning ducts in homes or commercial and industrial buildings

RUGGED—Unbreakable, metal-sheathed heating element. Fins are continuously furnace brazed to sheath. Both element and fin have thick ceramic coat for protection against atmospheric corrosion.

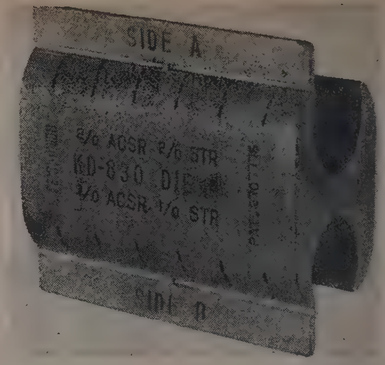
RELIABLE—U.L. listed. All current-carrying parts enclosed. Built-in cutout eliminates danger from air flow stoppage or reversal. Constant wattage for life of element. For new or old ducts, up to 36" x 48". Ratings from 120 to 550 volts, 1 to 100 kilowatts. Special designs to your specifications.



FREE—Write for new Catalog F40100.

32520

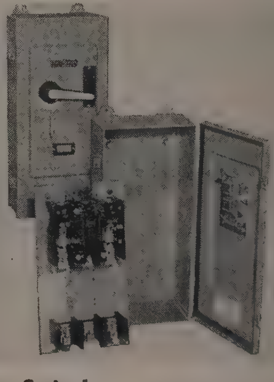
EDWIN L. WIEGAND COMPANY
7500 Thomas Boulevard • Pittsburgh 8, Pa. • Churchill 2-6400
CHROMALOX ELECTRIC HEAT



Connectors **(32)**

A complete line of spacer-type compression tap connectors of the "H" frame design for cable sizes from No. 6 solid through 400 MCM stranded aluminum or copper cable has been added to this line. Compression fittings use the conventional "O" and "D" compression dies up through 4/0 stranding. They utilize a new die size "N" from 4/0 through 400 MCM stranded cable. All connectors are made of high-conductivity EC Grade aluminum extrusions. The use of a spacer permits the recommendation of this connector with copper, aluminum or ACSR.

Penn-Union Electric Corp., Erie, Pa.



Safety Switch **(33)**

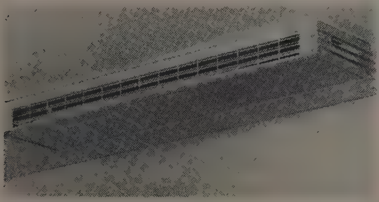
An improved safety switch for heavy-duty, industrial applications has been developed. It is available at present in NEMA 12 and NEMA 1A enclosures and is listed by UL as either a general-purpose disconnect device or as service-entrance equipment. Fusible or non-fusible safety switches are available from 30 through 600 amps, 240-volt and 600-volt ac and 250-volt dc. Switch and fuse load-block assemblies mounted on a removable steel plate. Bulletin No. 650-1 is available.

Continental Electric Equipment Co., Box 1055, *Cincinnati* 1, *Ohio*

Signal System (34)

A new signaling system featuring a miniaturized annunciator capable of indicating up to 100 different numbered signals in a 7 in. sq space, has been introduced. Signals are displayed on compact telescreen annunciators that are small enough to be mounted into a desk top, pen stand, small wall space or any convenient area. Numbered signals appear on the telescreen annunciator in numerals ¾ in., 1 in. or 3¾ in. high, and in numerical sequence as they are released from a Telestorage Director panel which serves as a memory and storage center. The panel controlling the system also contains the power supply which requires a primary source of 110 volts, 60 cycles. It can be placed in a remote area.

Auth Electric Co., Inc., Long Island City 1, N. Y.



Heater (35)

A new electric ceiling heater that can be used in new construction for kitchens and bathrooms, or in existing construction for supplementary heat in any room. Unit mounts directly on surface of ceiling. Depth is 2¾ in. It provides both radiant heat and air circulation by natural means. Air circulation is provided by vents on either side of unit. Air is heated and circulated across ceiling. Dimensions of heater are 9 by 36 in. It is 500 watts, and available for either 120 or 240 volts. Listed by UL.

Sun-Tron Corp., 7435 W. Wilson Ave., Chicago 31, Ill.

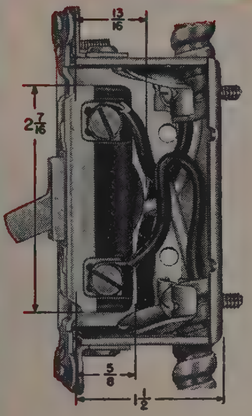
Motor (36)

A single-phase motor that is totally enclosed and fan cooled with capacities from 1 to 5 hp, has been introduced. Internal fans, cast integrally with the rotor, recirculate internal air and eliminate hot spots. External centrifugal switch has been mounted on outside of motor for accessibility. A protective cap is removed for access. Same switch fits all sizes of motors.

Brook Motor Corp., 3302 W. Peterson Ave., Chicago 45, Ill.

ARROW AH HART

Because of THIN-WALL CONSTRUCTION you asked for this NEW ARROW-HART SPACE SAVER Quiette SWITCH



H&H
SPECIFICATION GRADE
UL
No. 1101
15 amp.
120-277 volts, ac only

This comment is typical of many received upon the introduction of Arrow-Hart's exclusive SPACE-SAVER Quiette Switch. Here's why . . .

"This has been needed for a long time… space-wise as well as price-wise!"

EXTREMELY SHALLOW BASE . . .
only ⅝" from face to back. FITS 1¼" BOX.

GREATER WIRING ROOM . . .
making wiring easier, faster.

TWO WIRE ANCHOR HOLES . . .
at each binding screw for holding wire when looping around binding screw.

BIG BINDING SCREWS . . .
with deep-cut slots, for gripping wire firmly, assuring permanent holding and strong, positive connections.

QUIET, MECHANICAL ACTION

AVAILABLE IN BROWN OR IVORYLITE

FOR FULL INFORMATION . . . on the new Arrow-Hart Space-Saver Quiette Switch and the complete line of Arrow-Hart Quiette Switches, write to Dept ECM, The Arrow-Hart & Hegeman Electric Co., 103 Hawthorn St., Hartford 6, Conn.

ARROW AH HART
Quality since 1890

WIRING DEVICES · ENCLOSED SWITCHES
APPLIANCE SWITCHES · MOTOR CONTROLS

LOOK, MISTER!
No Hands
CHAMPION DeARMENT MEADVILLE, PA. U.S.A.

It's Self-Gripping

CHANNELLOCK®
No. 410
HEAVY-DUTY PLIER

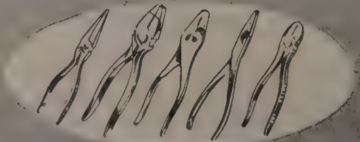
• How's this for gripping power? You won't know your own strength 'til you grab hold with this heavy-duty, self-gripping plier. The Channellock No. 410 HEAVY-DUTY is actually a combination plier-wrench . . . and it will get into tight places you can't reach with a pipe wrench. A mighty handy, multi-purpose tool with four jaw adjustments up to 1-1/8".

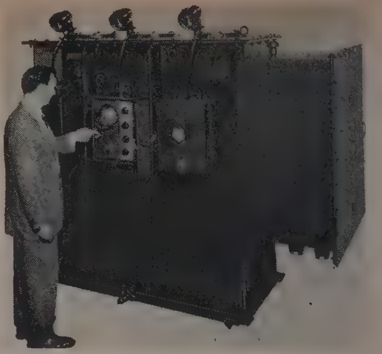
ASK YOUR TOOL SUPPLIER FOR A CHANNELLOCK No. 410 HEAVY-DUTY PLIER

BE SURE IT'S A GENUINE CHANNELLOCK

LOOK FOR THE TRADEMARK ON THE HANDLE

CHAMPION DeARMENT TOOL COMPANY • MEADVILLE, PENNSYLVANIA

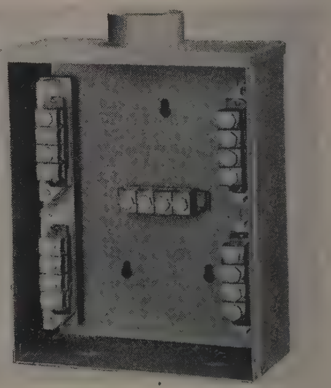




Regulator **(37)**

A new concept in voltage regulating equipment, called the Pole Star Tri-Unit regulator, has been announced. It consists of three well-known standard distribution-type Pole Star regulators—each a full-automatic, self-contained unit—combined in a single tank. Unit can be equipped with bushings for open-wire line connection, or a terminal compartment for cable connection. Voltage ratings are 15 kv and below.

Pennsylvania Transformer Div., McGraw-Edison Co., Box 330, Canonsburg, Pa.

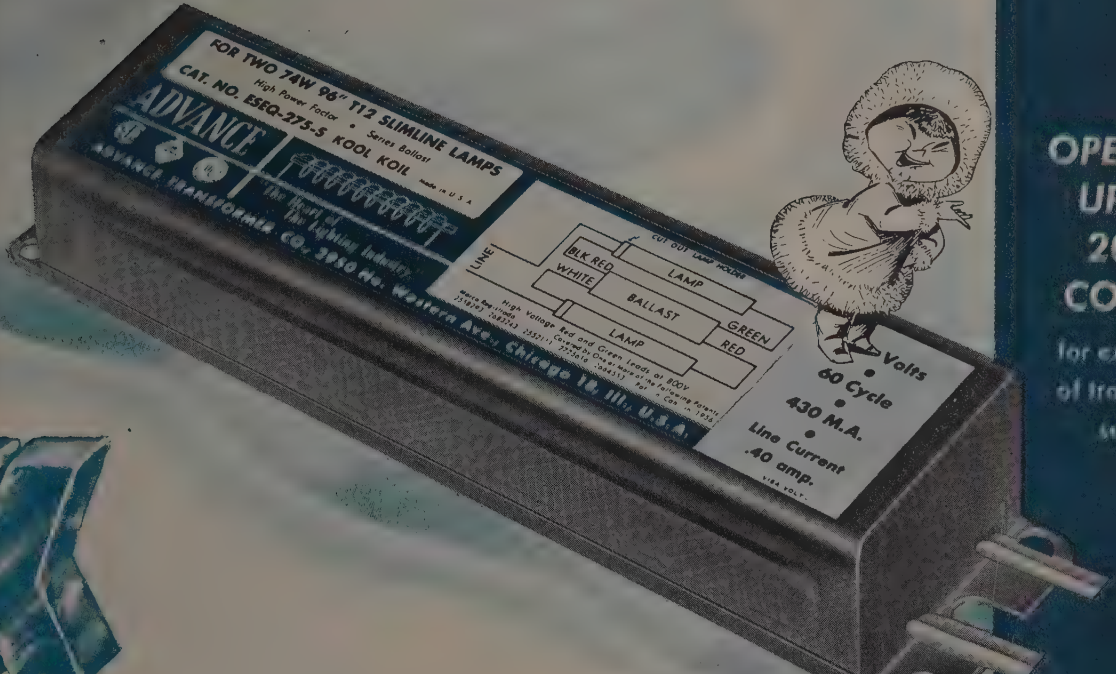


Terminal Boxes **(38)**

Weatherproof terminal boxes for 200-amp, 125/250-volt service contain from three to five bus bars to provide wiring connections for use in outdoor wiring. Models with three bus bars are used with single phase service and four bar models with 3-phase service. Five bus bar model is used for special applications such as split circuits and 2-phase, 4-wire service. In each model, one bar provides grounded neutral and other bars are insulated by ceramic mountings. Each bus bar has four pressure connectors accommodating either copper or aluminum wire up to No. 4/0.

Hoffman Engineering Corp., Anoka, Minn.

HE ADVANTAGES OF **KOOL KOIL**
COME AS TIME GOES ON....


FOR TWO 74W 96" T12 SLIMLINE LAMPS
High Power Factor • Series Ballast
CAT. NO. ESEQ-275-S KOOL KOIL
Made in U.S.A.
ADVANCE
"The Heart of the Lighting Industry"
ADVANCE TRANSFORMER CO., 2950 No. Western Ave., Chicago 18, Ill., U.S.A.
CUT OUT LAMP HOLDER
LINE
BLK RED
WHITE
LAMP
BALLAST
LAMP
GREEN
RED
High Voltage Red and Green Leads at 800V
Volts
60 Cycle
430 M.A.
Line Current
.40 amp.

OPERATES UP TO 20° C COOLER
for extra years of trouble-free service.

GIVES 15% MORE LIGHT OUTPUT
for higher illumination levels.

ADVANCE Fluorescent Lamp Ballasts are built to last years and years operating under normal temperatures. The rigorous demands required of Fluorescent Lamp Ballasts today often result in ballasts operating at abnormal temperatures reducing ballast life by one-half for every 10°C heat rise over normal operating conditions.

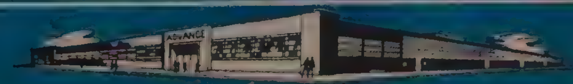
To meet today's requirements, ADVANCE engineers, through more than 3 years' exhaustive research developed ADVANCE Kool Koil Fluorescent Lamp Ballasts. Tests in a standard 40° C Certified Ballast Manufacturers and Underwriters Laboratories' heat box proved KOOL KOIL Fluorescent Lamp Ballasts operated 16.5°C to 19.5°C cooler than other quality ballasts. Because they operate up to 20°C cooler, they give 3 to 4 times longer service . . . operate long after others have failed.

Insist on ADVANCE KOOL KOIL Fluorescent Lamp Ballasts for that extra protection now and the years of trouble-free service that will be yours as time goes on.

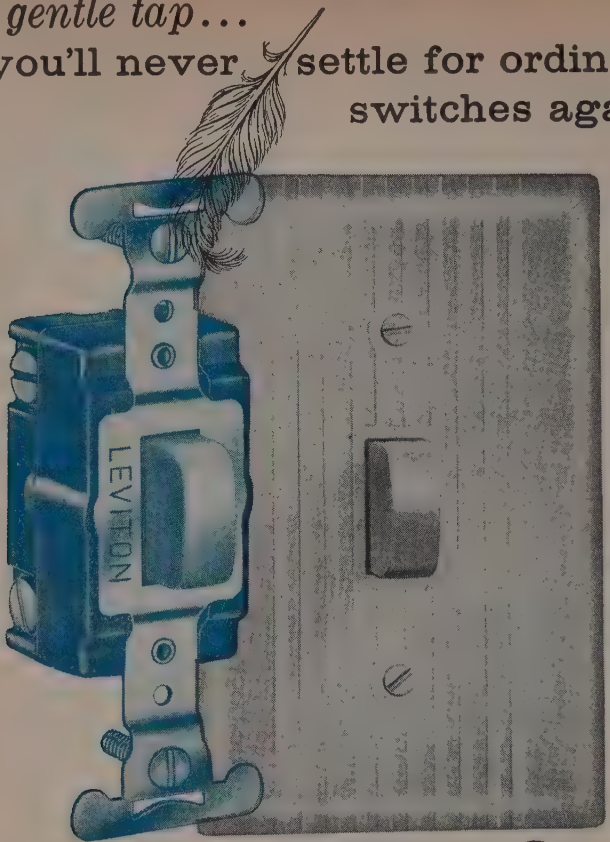
KOOL KOIL

DVANCE® TRANSFORMER CO.
World's Largest Exclusive Manufacturer of Fluorescent Lamp Ballasts
0 NO. WESTERN AVE. CHICAGO 18, ILL. U.S.A.

"The Heart of the Lighting Industry"



Mfg. in Canada by Advance Transformer [illegible] 5780 Pare St. Montreal, Quebec



a gentle tap...
and you'll never settle for ordinary switches again!

LEVITON A.C.
TOUCH SWITCH

Installs in any position...small enough to fit any gem box and standard wall plate ...and notice that quiet, "love tap" operation! Leviton's new 15A—120-277V. AC Touch Switch is a natural for homes, schools, apartments, office buildings, hospitals, industrial plants... anywhere! Tap it from any position, any angle!

CHECK THESE SPECIAL FEATURES:

SAFE OPERATION—install vertically, horizontally or upside down, yet a gentle tap gives positive, non-stalling action. Can't hang up...in any position. Special heavy silver contact points increase safety margin, prolong service life.

EASY INSTALLATION—side wired for convenience. Only 1" in depth. Large head brass terminal screws, backed out and staked, accommodate up to No. 10 conductors. Mounting screws are locked in straps ready-to-install. Interchangeable with any standard switch and wall plate.

HIGH CAPACITY—will accommodate high inductive loads of fluorescent systems, or full rated capacity of incandescent filament lamp loads. Take full load currents up to 80% of the switch rating for motor control.

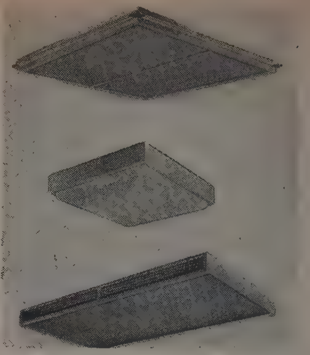
RUGGED CONSTRUCTION—simplified construction and advanced design assure maximum efficiency, long life under heavy duty use . Heavy gauge steel plaster ear straps are riveted to housing for permanent assembly.

Creatively engineered and subjected to exhaustive "in-use" tests, Leviton AC Quiet Switches have proven themselves ideal for the new 4-wire electrical systems requiring switches rated at 277 volts. Available with brown or ivory button.

Listed by Underwriters' Laboratories, Inc. For complete details write to:

Your best jobs are done with... **LEVITON**

Leviton Manufacturing Co Brooklyn 22, New York • Chicago • Los Angeles • Leviton (Canada) Ltd., Montreal.
For your wire needs, contact our subsidiary AMERICAN INSULATED WIRE CORP. Pawtucket, R. I.



Fluorescent Fixtures **(39)**

New line of slimlux surface modules offers complete versatility and variety for most every "on-ceiling" lighting requirement. Slim surface units are available in 1 by 4 ft, 1 by 8 ft, 1½ by 4 ft, 1½ by 8 ft, 2 by 2 ft, 2 by 4 ft, 2 by 8 ft, and 4 by 4 ft modules for rapid start and slimline lamps. Available with four different side designs and an array of bottom enclosures. Modules are constructed of heavy gauge, zinc-coated phosphatized steel and finished in new 300° baked-on white Acrylic enamel. All surface module units are listed by UL. Literature is available.

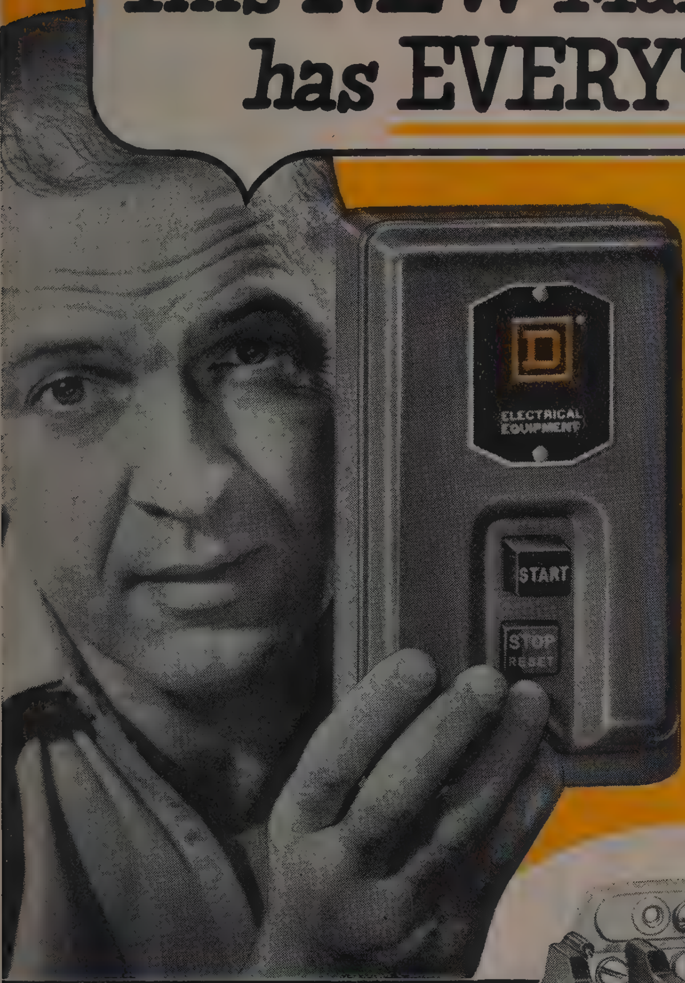
Edwin F. Guth Co., 2615 Washington Blvd., St. Louis 77, Mo.

Hoist **(40)**

A new aluminum hoist assembly is attachable to standard scaffolds, lifts and positions material for one-man overhead installation. Known as "Mechanical Man," it is for use in positioning fluorescent fixtures, bus ducts, conduit, pipe and sheet metal work for installations at any height. Material is placed on lifting arms and elevated along vertical track by winch. Lifting arms then move horizontally on rollers and elevate material to desired position above workmen.

Up-Right Scaffolds, 1013 Pardee St., Berkeley, Calif.

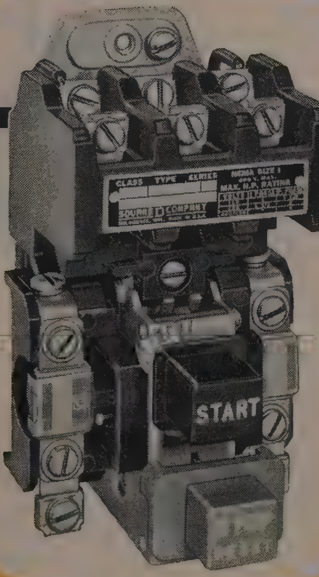
This NEW Manual Starter has EVERYTHING!



NEMA Sizes 0 and 1

Two, three and four-pole construction

- ***SMALLER!*** Takes less space, whether it's built into machine or mounted externally
- ***SMART STYLING!*** Matches the streamlined appearance of today's modern machines
- ***QWIK-MAKE, QWIK-BREAK!*** Positive snap-action opening and closing of contacts. Longer contact life
- ***TRIP-FREE OVERLOAD PROTECTION!*** Impossible for operator to hold motor circuit closed against overload
- ***POSITIVE PROTECTION!*** Starter will not operate *without* overload units installed
- ***LONGER LIFE!*** *Toggle Action* operating mechanism. Heavy-duty construction throughout
- ***EASIER INSTALLATION!*** Wire it without removing starter from enclosure. All terminals have pressure wire connectors
- ***EASIER MAINTENANCE!*** "Off-the-Shelf" parts kits make normal maintenance and modifications easier than ever. They're easy to buy, easy to identify, and faster to install
- ***TAMPER-PROOF!*** Cover padlocking device prevents tampering by unauthorized personnel. Safety latch locks "start" button in "OFF" position
- ***VISIBLE INDICATION OF OVERLOAD!*** Self-centering pushbuttons show when overload has occurred



CHOICE OF ENCLOSURES:

Water and Dust-Tight
Hazardous Locations
Flush Mounting

Write **for BULLETIN 2510 B-C**
Address Square D Company,
4041 North Richards Street,
Milwaukee 12,
Wisconsin

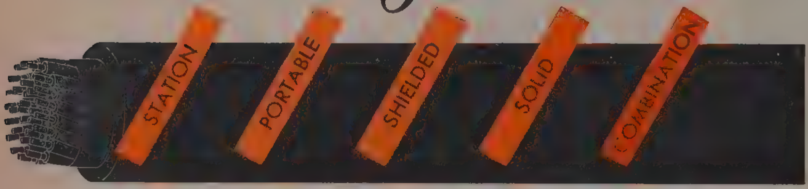
SQUARE D COMPANY

wherever electricity is distributed and controlled

CONTROL CABLES
FROM THE
BRONCO STABLES

BRIDLE YOUR HORSEPOWER WITH

BRONCO
Certified 66 NEOPRENE



There's now a multiple conductor Bronco cable for just about any control application you care to name. Any application where you've got to have out-and-out dependability, that is. They all have the famous Bronco 66 jacket, the jacket that is **certified** by a Registered Professional Engineer to contain not less than 67.32% neoprene—highest content in the industry. This is what makes Bronco 66 so highly resistant to oil, sunlight, ozone, abrasion, acids and other chemicals. Bronco 66 Station Control Cables also have a color-coded Neoprene jacket over the rubber insulation on each single conductor. They are built to meet I.M.S.A. (International Municipal Signal Association) Specification No. 5. Bronco 66 Portable and Shielded Control Cables have heat-resistant rubber insulation, vividly colored, coded in accordance with standards set down by N.E.M.A. and I.P.C.A. Bronco 66 **Portable** Control Cables are among the few that have U.L. approval (standards applicable to sizes 18 through 10 with any number of conductors). Bronco 66 Control Cables are made with from 5 to 60 conductors. They range in size from 18 through 2. Most popular sizes are carried in stock in a nation-wide network of warehouses. Outer protecting jackets are branded every two feet exactly. Type, size, number of conductors, rated voltage are molded permanently into the jacket by a patented* Bronco process so they can't be rubbed off. Write for the Control Cable section of the Bronco Catalog; some folks find it a kind of impressive roundup.

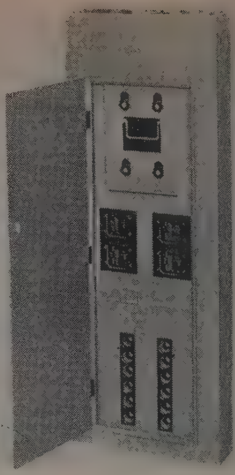
*U.S. Patent 2867001

BRONCO WESTERN
BRED FOR STAMINA

ASBESTOS CONTROL CABLE
a new Bronco entry

Bronco AVB Control Cable, insulated with asbestos and varnished cambric, covered with an asbestos braid, is a newcomer to the Bronco stable of championship performers.

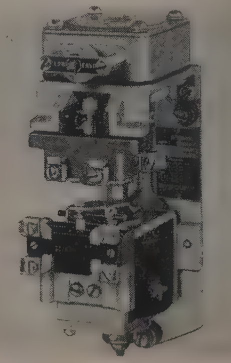
WESTERN INSULATED WIRE COMPANY
Los Angeles 58, California



Switch (41)

A new 200-amp entrance switch with a main 200-amp pullout, four 30-amp or 60-amp pullouts, and 12 fused branch circuits. One or two pullouts and two or four branch circuits can be added at any time. All "Add-On" pullouts and branch circuits for this 200-amp switch are interchangeable with similar units used in A-H 100-amp entrance switches. The 14⅜-in. width is designed to allow installation between studs. Neutral terminal bars accept wire sizes from 4 to 14.

Arrow-Hart & Hegeman Electric Co., Hartford, Conn.



Interlocks (42)

Two single-pole double-throw instantaneous interlocks can now be furnished on Class 9050 Type C, dc timers. Timers can be ordered with interlocks factory-installed, or separate interlock kits are available for field installations. Timers have an adjustable timing range of up to three minutes, and can be changed from on-delay to off-delay with a conversion kit. Timer head is front-removable, permitting change without removing timer from panel.

Square D Company, 4041 *North Richards St., Milwaukee* 12, *Wis.*

COLD WEATHER ?

FREE SAMPLE! SCOTCH BRAND ELECTRICAL TAPE No. 88

REG. U.S. PAT. OFF.

FIRST ALL-WEATHER ELECTRICAL TAPE

Now at last a "super" tape to handle the toughest cold weather splicing jobs. New "SCOTCH" BRAND Electrical Tape No. 88 is 20% thicker than ordinary plastic tapes. Retains its easy handling properties and "feel" under all temperature conditions. UL approved. Resists acids, abrasion, alkalies, oils and weathering. Send in the coupon for free 9 ft. sample roll.

Made by the makers of "SCOTCH" BRAND No. 33 Electrical Tape.

SEE US AT THE Sixth National Electrical Exposition, Las Vegas Convention Center, Oct. 23—26, Booth 101.

MINNESOTA MINING AND MANUFACTURING COMPANY
. . . WHERE RESEARCH IS THE KEY TO TOMORROW
3M COMPANY

SEND IN TODAY

3M Co., 900 Bush Ave., St. Paul 6, Minn., Dept. EAA-100
Send me a free sample roll of "SCOTCH" BRAND Electrical Tape No. 88

NAME____________________

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ADDRESS____________________

CITY__________ STATE__________

Electrical Products Division

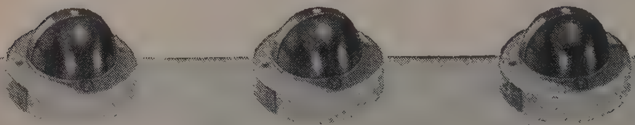
"SCOTCH" IS A REGISTERED TRADEMARK OF 3M CO., ST. PAUL 6, MINN.

Fire detection is big business!
Cash in now with Kidde equipment!

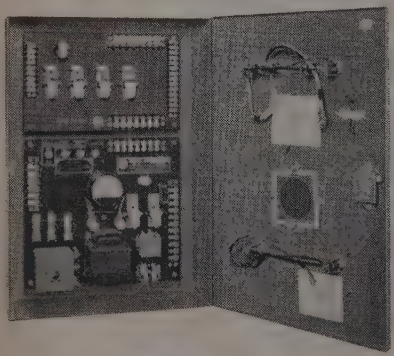
For years, schools, public buildings, businesses and homes have been waiting for an inexpensive, dependable fire detection system approved by U.L. and F.M. Now you can sell them this vital detection system at a reasonable price. When you sell a Kidde fire detection system and install it yourself, there are thousands of dollars in potential profits for you.

And, selling Kidde, you can be sure that you're selling quality. For more than 30 years, Kidde has been the leader in fire safety. It's a name you and your customers can trust!

Find out more about Kidde fire detection components—and how you can use them to cash in on these most profitable markets! For more details, write Kidde today.

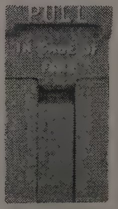


Kidde Fyrindex detectors. Self-resetting, fast-acting, easy to install. Fixed-temperature units each protect up to 225 sq. ft. Rate-of-temperature-rise models protect to 900 sq. ft. Combination rate-of-rise, fixed-temperature units each protect 2500 square feet. All U.L. and/or F.M. approved.



Control, rectifier, zone annunciator panels contained in one cabinet. Monitors up to ten zones. 12 or 24 v., dc.

Kidde weatherproof alarm bells – 6", 8", and 10" diameter. U.L.-approved.



Manual alarm pull for one or more stations.

Kidde

Kidde Ultrasonic & Detection Alarms, Inc.
1085 Brighton Road, Clifton, New Jersey

A Subsidiary of Walter Kidde & Company, Inc., Belleville 9, N. J.

Switch **(43)**

New, weatherproof Solachron automatic electronic light and time switch is a complete control unit for outdoor electric signs and other commercial lighting. It combines a standard 4-way time clock and the Solatrol electronic switch. This photoelectric switch automatically turns on lamps at darkness and switches them off at daylight. The Solachron SC-110 and SC-111 are rated for lighting loads up to 1000 watts.

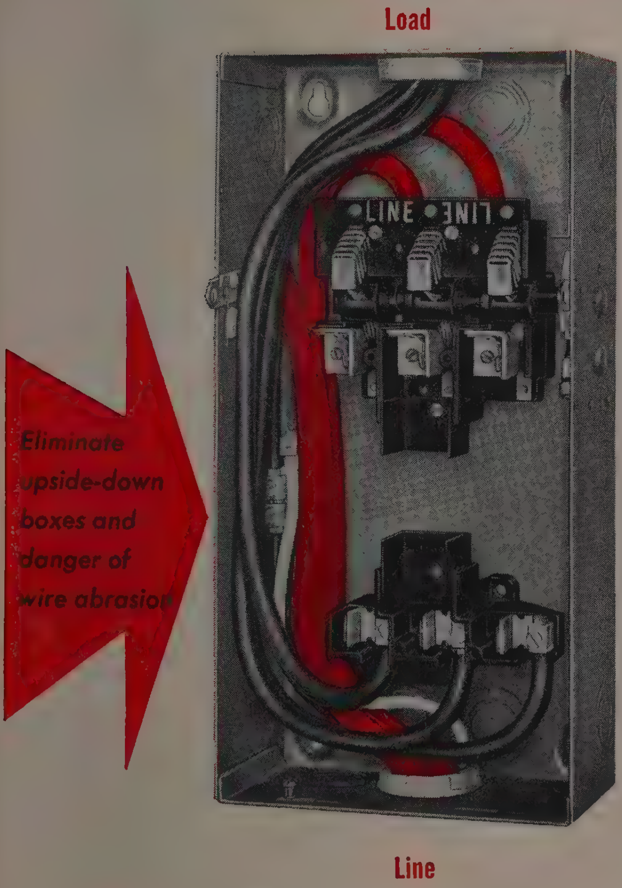
Solar Sonic Devices, Inc., Div. of Perfect-Line Mfg. Corp., Hicksville, L. I., N. Y.

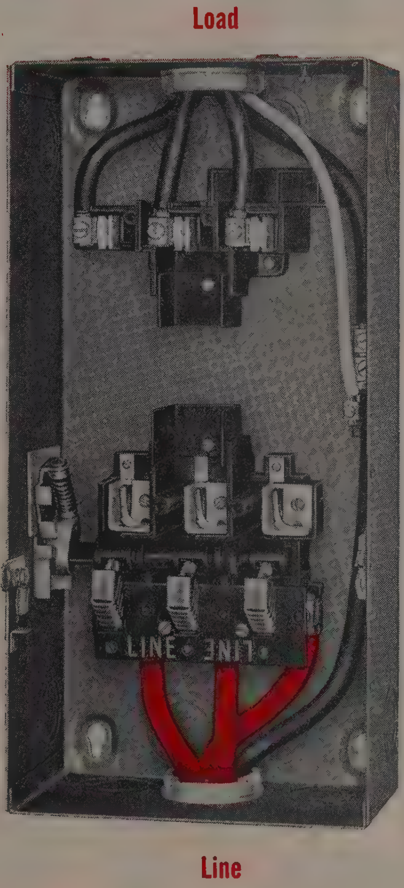
Luminaires **(44)**

New internally ballasted mercury luminaires for pole-top mounting, designated Line 2E2, are designed for high-level lighting of streets, highways, and parking areas. They accommodate clear or color-improved mercury lamps rated 700 and 1000 watts and produce IES Types III and IV light patterns. They provide a 35-ft mounting height when installed on 30-ft poles. A permanent-mold cast-aluminum base encases ballast, terminal block, and collet-type clamps for attaching luminaire to steel or aluminum poles. Units are furnished with or without an integral photoelectric control.

Line Material Industries, McGraw-Edison Co., Milwaukee 1, Wis.

Save up to $30 on cable cost with new G-E reversible-wiring safety switches





Old way wastes wire, work and money. Looped cable inside box presents danger of wire abrasion. None of this is necessary when you use new General Electric reversible-wiring safety switches, 100-amp and above.

New G-E way eliminates danger of wire abrasion, inconvenience of upside-down boxes. ON-OFF indication remains unchanged. Available with line lugs factory-installed at bottom, or for field installation.

SCHEDULE OF SAVINGS ON CONDUCTOR COSTS

Switch Rating	Conductor Size	Amount Saved Per Switch Installed*		Length of Wire Saved (In Feet)	
		2-Pole	3-Pole	2-Pole	3-Pole
100 AMP	2	$ .91	$ 1.36	5	8
200 AMP	3/0	3.73	5.60	9	14
400 AMP/240 VOLT	500 MCM	12.56	18.90	11	16
400 AMP/600 VOLT	500 MCM	13.74	20.60	12	17½
600 AMP/240 VOLT	(2) 350 MCM	18.70	28.10	22	33½
600 AMP/600 VOLT	(2) 350 MCM	20.40	30.60	24	36½

*Based on approximate contractor prices for Type RHW copper building wire.

GENERAL ELECTRIC

Circuit Protective Devices Dept., Plainville, Conn.

It pays to figure on

KEYSTONE

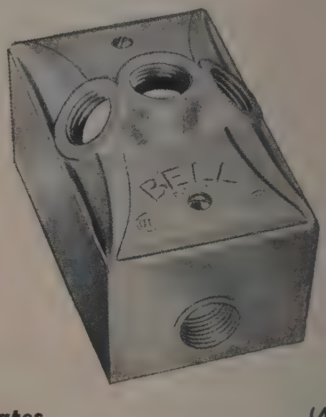
Keystone offers a complete line of liquid-tight, J.I.C. and Nema wiring enclosures designed to give positive, sealed protection against dust, dirt, oil, water and coolants! All wireways, fittings, troughs, boxes and cabinets are produced to J.I.C. and Nema specifications—and all are available in a wide range of sizes *to meet your exact requirements.*

KEYSTONE MANUFACTURING CO.
Division of AVIS INDUSTRIAL CORPORATION
23330 Sherwood Avenue • Warren, Michigan

Circuit Breakers **(45)**

The line of Type QO circuit breakers has been expanded with the addition of the Type Q1 breaker, available in 70- and 100-amp trip ratings for 2- and 3-pole applications. Standard Q1 breakers are supplied with terminals suitable for use with both copper and aluminum conductors. Lugs are UL listed for copper cable Size No. 1 to No. 8 AWG and aluminum cable Size No. 0 to No. 6 AWG. Plug-in construction simplifies installation; Q1 breakers can be wired outside box and then plugged on to bus for line connection. Type Q1 breakers fit all existing Type QO load centers and NQO panelboards.

Square D Company, Mercer Road, Lexington, Ky.



Plates **(46)**

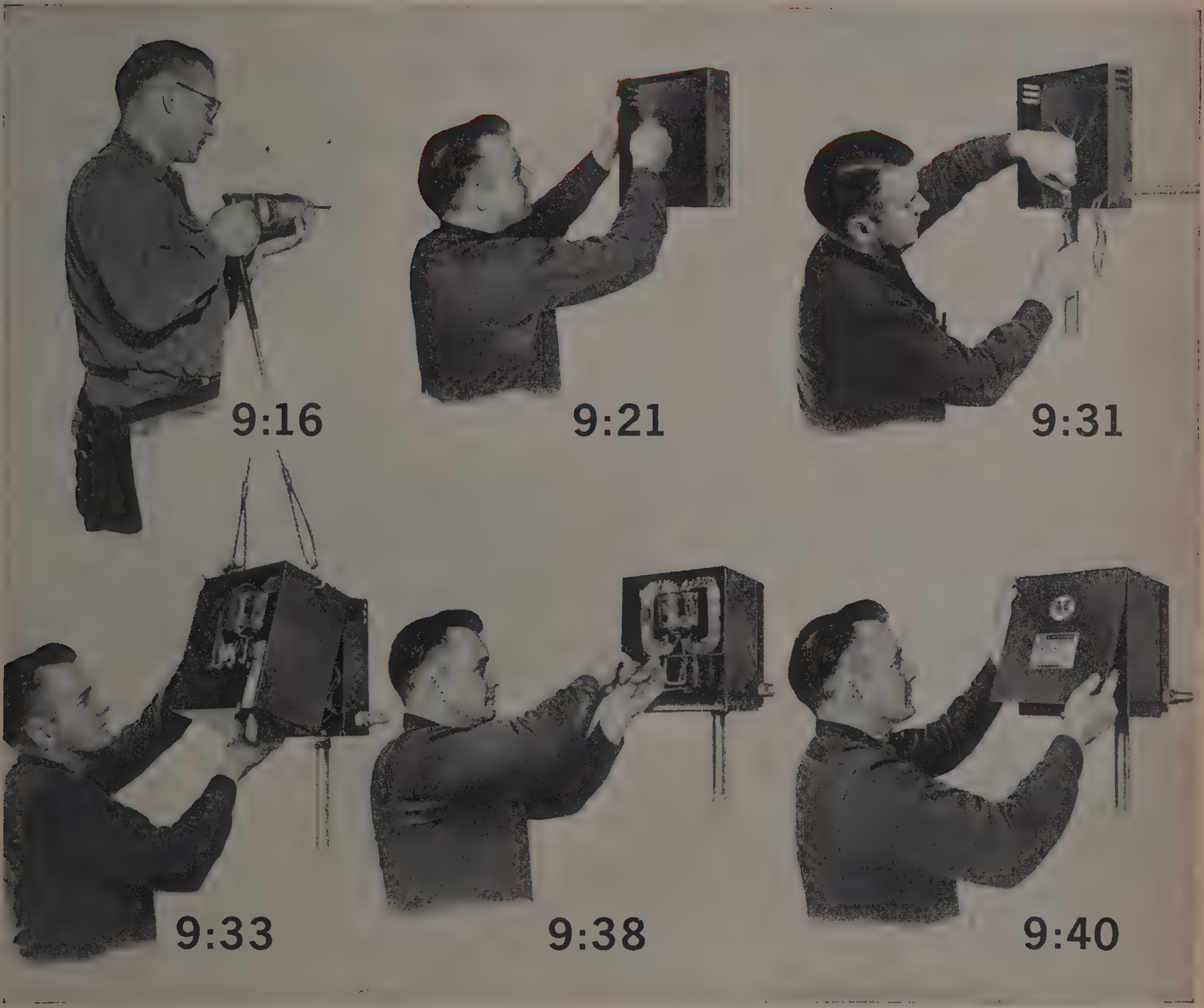
A new line of cluster lighting cover plates for weatherproof junction boxes for use with single or multiple outdoor flood or spot lights. Cast aluminum cluster cover plates are available in standard rectangular or round shapes, with one, two or three ½ in. threaded outlets. Plates are rustproof, corrosion-resistant, CSA and UL listings. They are finished in baked aluminum enamel.

Bell Electric Co., 5735 S. Claremont, Chicago 36, Ill.

ALLIS-CHALMERS

A-C
ALLIS CHALMERS

A-1360



9:16 — 16 minutes to drill 4 holes in concrete wall and add lead inserts to receive screws. **9:21** — 5 minutes to mount back panel to wall. **9:31** — 10 minutes to punch out knockouts and attach conduit. **9:33** — 2 minutes to put center case section in place and tighten side screws. **9:38** — 5 minutes to pull cables and connect to terminals. **9:40** — 2 minutes to fasten front panel to center section with side screws. **Installing time: 40 minutes instead of the usual hour and a half!**

35% smaller, lighter, new whisper-quiet dry-type transformers

cut installing time in half!

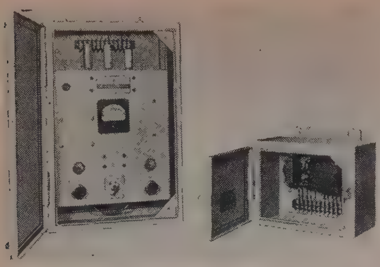
New A-C design eliminates common installation problems! Unique 3-piece case makes handling, wiring go like clockwork. 35% smaller and lighter, you can install them in 40 minutes instead of the usual 90 minutes.

And they're whisper-quiet. Every known factor in subduing noise has been incorporated . . . core impregnation, core and coil assembly suspension isolated from case . . . plus use of nonresonate casing. Exclusive *Curvacore* construction lowers exciting current, core losses.

This new 600-volt class indoor dry-type transformer line is available in sizes 3 to 50 kva . . . for on-the-site load center applications where critical voltage must be maintained.

See your nearby A-C office for details or contact **Allis-Chalmers,** *Power Equipment Division, Milwaukee 1, Wisconsin.*

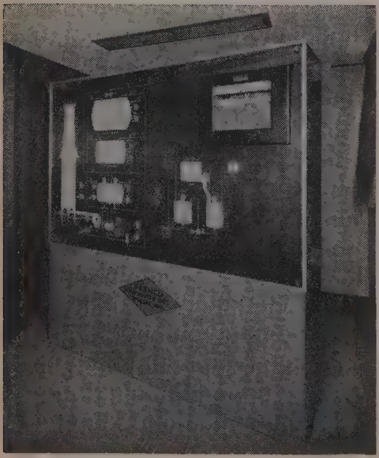
Curvacore is an Allis-Chalmers trademark



Monitoring Devices (47)

TorqueTrol is an ac motor-load monitoring device which responds to actual power. Device will detect very small motor-load changes in a machine. Unit monitors motor torque, which is directly proportional to power. Features include: unit will respond to actual power demands instead of current alone; reacts to load variations; has heavy-duty output relay; will respond to underload or overload. Relay-type output can be used to stop motor; operate an alarm or signal system; count work cycles, etc.

Clark Controller Co., 1146 *E.* 152*nd St., Cleveland* 10, *Ohio*



Annunciators (48)

A new line of low-cost annunciators for visual monitoring of remotely actuated, remotely controlled systems of all kinds is now available. Designated Series PA annunciators, the units are produced in a variety of sizes to meet a wide range of architectural requirements and system specifications. They are available with or without integral recording apparatus. Standard PA-2R cabinet measures 78 in. high by 72 in. wide by 18 in. deep. Annunciator is used to monitor an industrial incineration system for the disposal of cyanide wastes. It consists of a combination visual monitoring and control panel. It provides backlighted component silhouettes for visual monitoring of all major system cycles and contains operation control buttons for all major cycles which are electrically tied to system operating relays in a remote electrical panel.

Prenco Mfg. Corp., 2605 *W.* 14*th Mile Road, Royal Oak, Mich.*

Paging System (49)

A personal radio paging system, capable of providing selective voice communications to more than 7,500 persons, has been developed. The system, which operates on standard mobile radio VHF frequency bands (25-54 mc and 144-174 mc), enables one-way communications between a central base station and individuals carrying "Handie-Talkie" radio paging receivers. When an individual is paged, an alerting tone sounds in his receiver. Voice message follows. Private communications are maintained since no other paging receiver is alerted. For low capacity systems, a compact desk-top pushbutton control console is utilized with a regular two-way radio base station. Tone generators are included in the console. Up to 90 calls are provided with each console. Four consoles can be used in a single system, permitting up to 360 calls.

Motorola Inc., 4501 *West Augusta Blvd., Chicago* 51, *Ill.*

Switch (50)

A new safety switch, for use on access doors leading to plenums in air-conditioning systems or other chambers where there is a possibility of shock hazard to service personnel, has been developed. Before the access door can be opened, a wing nut must be manually unscrewed. This unlocking operation immediately interrupts the primary power from the generator thus preventing a resumption of power should the door blow closed after a man has entered the chamber. Switch cannot be locked "On" with the access door open, thus requiring a second man at the switch if high voltage equipment is to be checked. Switch bears UL and CSA labels. Model S911 allows for full flexibility of location and position on either left or right hand door opening, and has SPST normally open contacts rated at 15 amps, 125 volts ac.

CRS Industries, Inc., 1405 *Locust St., Philadelphia* 2, *Pa.*

Aerial Lifts (51)

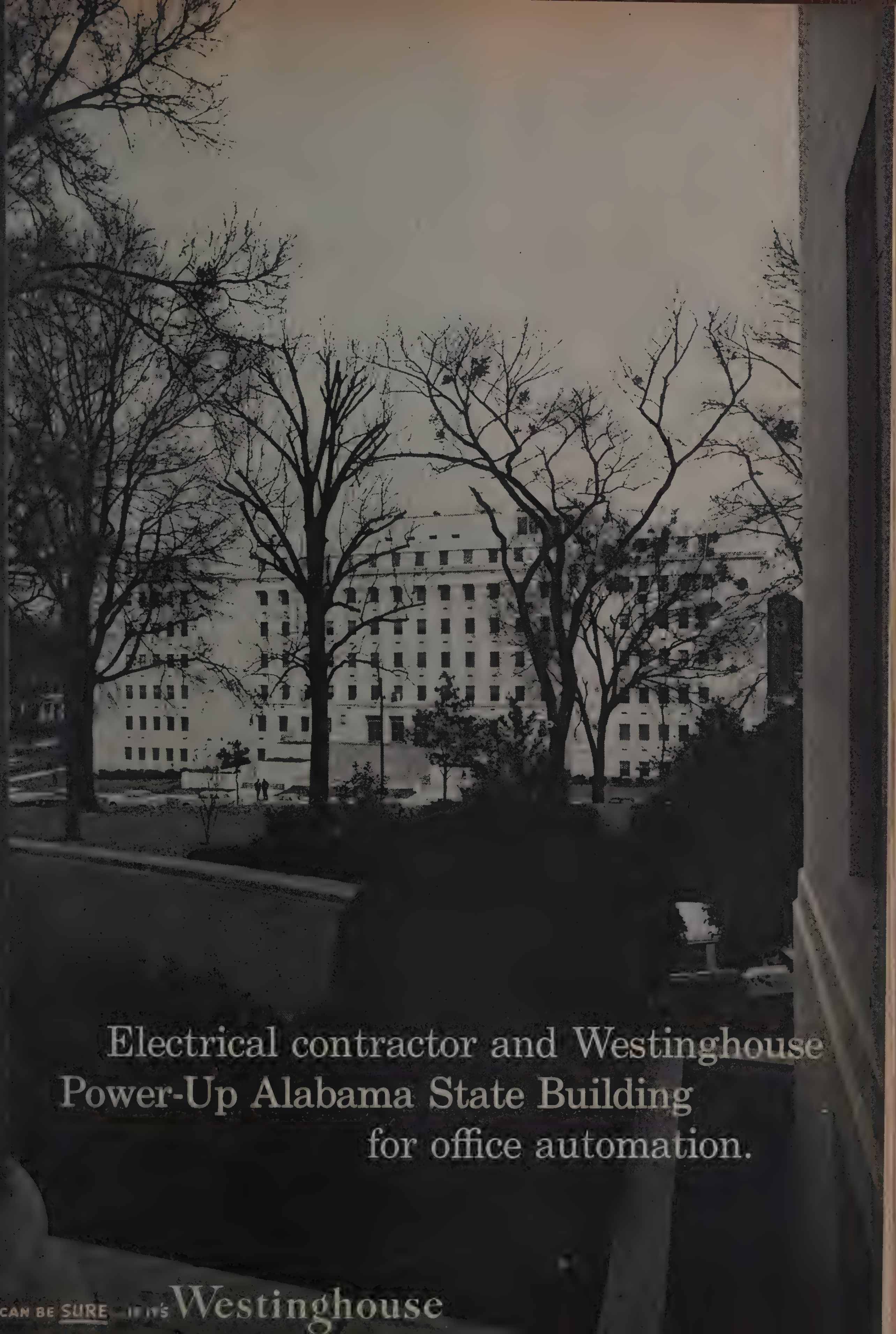
Designed for a wide variety of utility, municipal and industrial overhead operations, the new Service-Lift units may be mounted on vehicles as small as 1-ton trucks. Two standard models are available, one with 36-ft working height, the other with 40-ft working height. Both models are canopy mounted on an "H" frame which leaves deck and compartment space clear. Entire structure, which includes crow's nest, upper boom, lower boom, and turret arm, is built of fibreglas. Primary power source is a standard commercial electric generator, (3500-watt ac, 220-volt, 3-phase, 4-wire) driven by auxiliary motor or by truck engine. Normal lift operations use only half the generator output, making power available for floodlights, power tools, etc. Continuous 360° horizontal rotation of entire unit with no stopping point.

Hunt-Pierce Corp., 59 *Meadow St., Milford, Conn.*

Power Generators (52)

Diesel power-generating sets capable of delivering a full load of electric power within 8 to 30 seconds after starting from a dead stop, to safeguard cities from blackout when main power sources go dead, have been developed. The six engines can start automatically in case the prime source of power fails. They are capable of supplying 12,000 kw of power, at 16,800 hp, in the farthest northern power station in the western hemisphere. Engines are turbo supercharged opposed-piston diesels.

Fairbanks, Morse & Co., subsidiary of Fairbanks Whitney Corp., 745 *Fifth Ave., New York* 22, *N. Y.*


Electrical contractor and Westinghouse
Power-Up Alabama State Building
for office automation.
CAN BE SURE ... IF IT'S Westinghouse

COVER PHOTO
Newest facade on Alabama's Capitol Hill is the seven-story, 258,500-square-foot State Administration Building shown on cover. The building houses 17 state agencies, will eventually be the "working home" for more than 1100 Alabamians.

New State Administration Building is geared for latest "office automation" techniques like data processing area *(at right)* which handles a steady flow of facts and figures. Westinghouse Type SC fluorescent luminaires, ceiling mounted for fast installation, provide an attractive and cheerful work area for state employes.

Teamwork paid off for the new Alabama State Administration Building. Careful evaluation of all building functions, sound planning and careful coordination produced a modern electrical distribution system—installed on time—that's ready to meet all present demands, anticipates future needs. Tandy Little, Jr. *(center)*, partner T. D. Little Electric Co., reviews specifications with O. E. Hatcher, Westinghouse Area Sales Manager; H. D. Mosley, Mosley and Yarbrough, Consulting Engineers; F. J. Sarknas, Westinghouse Construction Sales Engineer; R. F. Kirkpatrick, Sales Engineer, Moore-Handley Hardware Co.; and C. H. McCauley, Architect.

J-94141-2

Planning, coordination and Westinghouse on-time delivery mean installation efficiency for electrical contractor

On the campus-like grounds around its gracious Capitol, the State of Alabama has erected a modern State Administration Building, reflecting Alabama's progressive outlook. In this newest addition to the Capitol buildings, data processing machines handle quarterly income tax notices, automobile registrations, numerous statistical reports, sales tax, etc. As many as 38 machines and other electrical equipment operate during one shift in one department alone . . . office automation that requires reliable power in large demands.

The electrical contractor, T. D. Little Electric Co., teamed up with consulting engineers, experienced Westinghouse engineers and the Westinghouse distributor to work closely with state officials, the architect and general contractor on system installation. Result: an electrical system carefully planned and executed to distribute efficiently the big power load . . . a system with expansion capability to keep the building modern for years to come . . . a system installed at a "saving" in direct comparison to other buildings on the "campus."

The electrical installation went off on schedule with building construction because of contractor-Westinghouse coordination and on-time deliveries by the Westinghouse distributor, Moore-Handley Hardware Co.

Westinghouse electrical equipment — reliable, adaptable and easy to install—was used throughout the building.

Included are a building-type switchboard, motor control center, distribution and lighting panelboards, low-impedance bus duct, circuit breakers, safety switches and fluorescent lighting. *(cont.)*

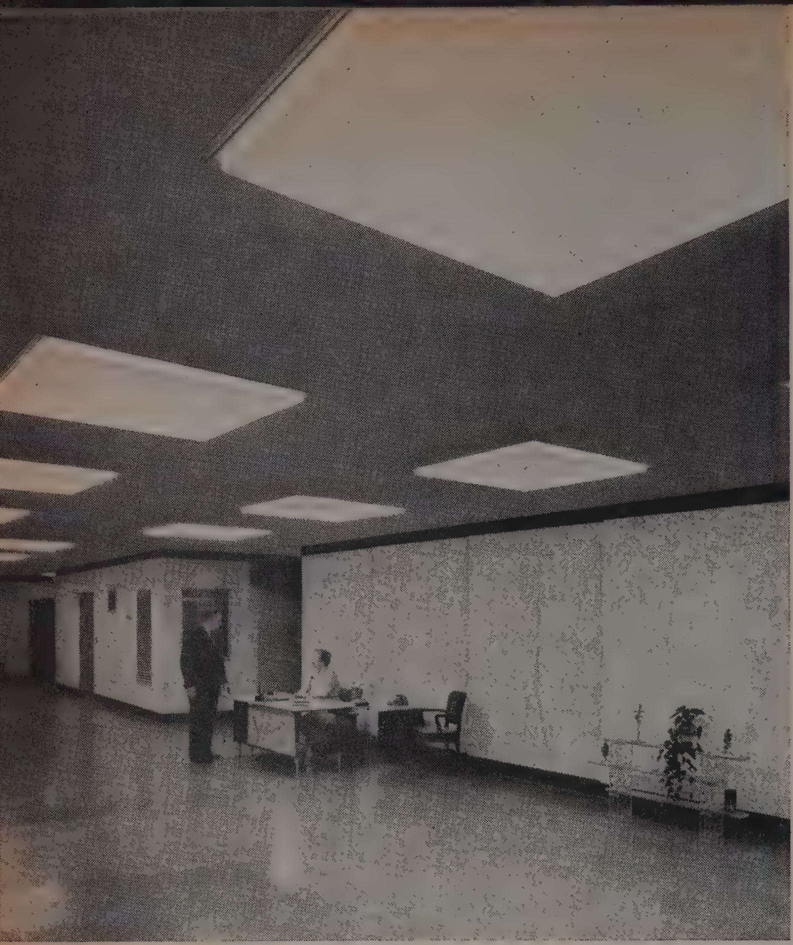
YOU CAN BE SURE...IF IT'S Westinghouse

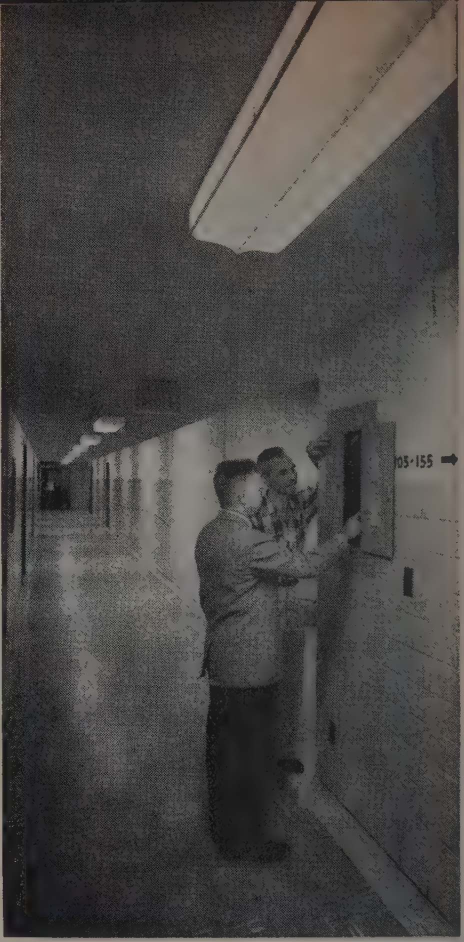
J-94141-3

A 120/208-volt Westinghouse building-type switchboard protects and distributes power to all floors. Note blank sections for future system growth. Ventilated low-impedance bus duct, rated 3000 amps, conducts incoming power to switchboard from a bank of three 250-kva, Type SL, oil-insulated transformers. Mills Cowling, Chief of Service Division, State of Alabama; W. C. Sparks, Vice President, Moore-Handley Hardware Co., Westinghouse Distributor; T. D. Little, Sr., T. D. Little Electric Co., Electrical Contractors; and F. J. Sarknas examine future expansion features designed into switchboard.

Exhaust fan, elevator, air conditioning compressor, water pump and air handling equipment motors are served by a 480-volt Westinghouse motor control center which consists of Class 11-206 motor starters. Motor control center receives power supply from transformer vault by 1350-amp, low-impedance bus duct with many time-saving installation features. H. D. Mosley; O. E. Hatcher; William Lawrence, Jr., Deputy Director of Technical Staff, Alabama Building Commission; and C. H. McCauley inspect compact, efficient installation.

Westinghouse 1000-amp low-impedance ventilated bus duct efficiently distributes power to Westinghouse Type CDP distribution panelboard from distant switchboard with minimum voltage drop. H. D. Mosley and H. H. Houk, Director of Technical Staff, Alabama Building Commission, check neat bus duct installation as C. H. McCauley and O. E. Hatcher review circuit breaker arrangements in panelboard.





Planning, coordination and Westinghouse on-time delivery mean installation efficiency for electrical contractor *(cont.)*

Many outstanding electrical contractors have found Westinghouse equipment, coupled with localized Westinghouse service, the solution to power distribution system problems and a key way to increase installation efficiencies. Westinghouse can aid you in any phase of your electrical planning and construction. Call your Westinghouse distribution outlet or write Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pennsylvania. J-94141-4

OWNER: State of Alabama
ARCHITECT: Charles H. McCauley, Birmingham, Ala.
CONSULTING ENGINEER: Mosley and Yarbrough, Montgomery, Ala.
GENERAL CONTRACTOR: A. C. Sanford, Albany, Ga.
ELECTRICAL CONTRACTOR: T. D. Little Electric Co., Montgomery, Ala.
WESTINGHOUSE DISTRIBUTOR: Moore-Handley Hardware Co., Birmingham, Ala.

YOU CAN BE SURE...IF IT'S Westinghouse

Alabama marble and Westinghouse Mainliner fluorescent fixtures combine to form an attractive welcome for employes and visitors in new Alabama State Administration Building. Westinghouse Mainliner large area luminaires have universal ease of application with installation flexibility. *Above,* R. F. Kirkpatrick points out details of Westinghouse lighting panelboard, Type NLAB, 120/208 v, to G. D. Schnell, member of the maintenance staff. Circuit breaker panelboards provide maximum circuit protection for Westinghouse Type SC fluorescent lighting luminaires used in corridors.

Tandy Little, Jr., typifies progressive qualified electrical contractors who are helping America to Power-Up. He holds an electrical engineering degree and is president of Central Alabama Chapter of the National Electrical Contractors Association. A partner in T. D. Little Electric Co., he has responsibility for job management, contract negotiation, estimating and buying. His preplanning, business judgment and knowledge of currently available electrical products were big factors in the efficient electrification of the new Alabama government building.

T. D. LITTLE JR.

Catalogs, Bulletins and Engineering Data

(53) SWITCHES. Catalog 110 gives details on all basic precision switches along with variations available. Catalog 100 is a reference guide to the most popular switches in the line. Controls Switch Div., Controls Co. of America.

(54) PANELING. Bulletin features Electroluminescence paneling being developed for military, industrial and commercial application. Control Switch Div., Controls Co. of America.

(55) LIGHTING in textile mills is subject of 12-page booklet "Higher Profits Through Better Textile Lighting." General Electric Co.

(56) CLASSROOM TV VIEWING is described in bulletin "Arranging the Classroom for TV Viewing." Sylvania Lighting Products Division.

(57) SYNCHRONOUS GENERATOR. BEMAC, the brushless exciter magnetic amplifier controlled packaged synchronous generator, is featured in product publication 2100-PRD-255A. Electric Machinery Mfg. Co.

(58) CONTROL. An eight-page folder entitled "Practical Approach to Photo Electric Control." Com-Pak-Ett Mfg. Corp.

(59) LIGHTING. 4-page folder describing and illustrating the Quartz line of high-intensity floodlights. Guardian Light Co.

(60) PHOTOELECTRIC CONTROLS of outdoor lighting fixtures is described in 24-page data file including data for temperature characteristics, time delay, and installation of meter-type controls. Precision Multiple Controls, Inc.

(61) LIGHTING FIXTURE. The shallow "Coronado" units adaptable to offices, schools and banks are described in new catalog. Benjamin Div., Thomas Industries, Inc.

(62) BATTERY CAPACITY. Brochure No. GB-1661-A presents a method for determining capacity of batteries that have been in service for over three years. Three examples of actual tests are given in detail. Gould-National Batteries, Inc.

(63) ELECTRICAL CONNECTORS are described in bulletin PR259-1 which covers technical information, ratings and outline dimensions on new single-conductor plugs and receptacles. Superior Electric Co.

(64) MINIATURE TRANSFORMER information, diagrams and detailed specifications are described in new 1961 catalog. Typical special transformers, designed and manufactured to customer specifications, are listed. Microtran Co., Inc.

(65) SIGNAL EQUIPMENT suitable for industrial needs is shown in new 16-page catalog. Complete diagrams, specifications and mounting methods for all listed signal equipment are given in detail. Benjamin Div., Thomas Industries, Inc.

(66) LAMP SERIES. Brochure R-260 describes line of table and wall lamps designed for lighting and functional styling in the home, office, commercial, institutional and industrial areas. Rodisco, Inc.

(67) MAGNETIC STARTERS featuring unitized construction with all components front-removable are described in Bulletin 14-B2. Furnas Electric Co.

(68) FLUORESCENT TROFFER, adaptable to practically all ceiling systems, is described in new bulletin. The new Universal II troffer is designed for commercial, institutional and public buildings. Pittsburgh Reflector Co.

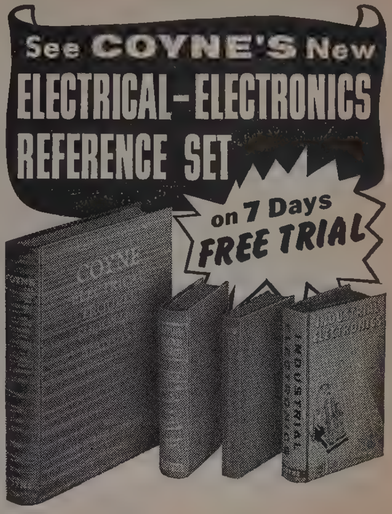
(69) LIGHTING idea book, "How to Get More Out of Life with Light," contains useful selling ideas to contractors. Lightolier Inc.

(70) BATTERY SELECTION CHART for electric industrial trucks is contained in 8-page brochure including dimensions, ampere-hour capacities and weights. Gould-National Batteries, Inc.

(71) BUSWAY. Speedbus, a new 100-amp packaged busway for installation in industrial and commercial buildings is described in catalog 698. National Electric Div., H. K. Porter Co., Inc.

(72) RANGE HOODS, ventilating fans and accessories are described

Electricians! Maintenance Men!



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for 100 to 200 ampere housepower

for real economy in
service entrance installations

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Send for complete M & W Catalog today!

Electrical Fittings
The M. & W. ELECTRIC MFG. CO., Inc.
EAST PALESTINE, OHIO

in new 16-page catalog 268-L including features, complete specifications, dimensions and installation. Leigh Building Products, Div. of Air Control Products, Inc.

(73) LIGHTING FIXTURES. A new series of ceiling mounted and wall mounted lighting fixtures are described in 4-page brochure R-160. Rodisco, Inc.

(74) ELECTRICAL CONDUCTIVITY ratings of 56 copper alloys are contained in 8-page bulletin "Bridgeport Metals for Electrical and Electronic Apparatus." Bridgeport Brass Co.

(75) ELECTRIC MOTORS. 14-page idea book and condensed catalog contains useful data for designing, selecting and specifying special motor designs. Doerr Electric Corp.

(76) PHOTOELECTRIC SCANNER RELAY that provides an adjustable time delay between the changing of light, is suitable for light or dark operation. Described in new bulletin PE-5. Farmer Electric Products, Co., Inc.

(77) CABLE MARKING SYSTEM is described in six-page catalog including in-use illustrations, specifications and traceable drawings. Electrovert Inc.

(78) ELECTRONIC package control sets specifically designed for temperature control of all valve-type classroom unit ventilators are described in sales brochure F-9754. Barber-Colman Co.

(79) AIR CONDITIONERS. 12-page bulletin 8825 discusses performance characteristics and engineering features with typical installation photos. American-Standard Industrial Div.

(80) POWER SUPPLIES. Bulletin 204A describes the new output range of medium voltage dc power supplies of 0-125 VDC. Opad Electric Co.

(81) MOTORS. Single page product publication, 1100-PRD-253, describes line of pedestal-bearing type, heavy-duty, synchronous motors. Electric Machinery Mfg. Co.

(82) ELECTRIC MOTOR CONTROLS. 56 pages of descriptions, ratings and prices for manual and magnetic starters, drum controllers, pressure, foot and limit switches. Furnas Electric Co.

(83) INSULATING TAPE. Technical bulletin 18,110 describes new line of silicone rubber tape. Continental-Diamond Fibre Corp.

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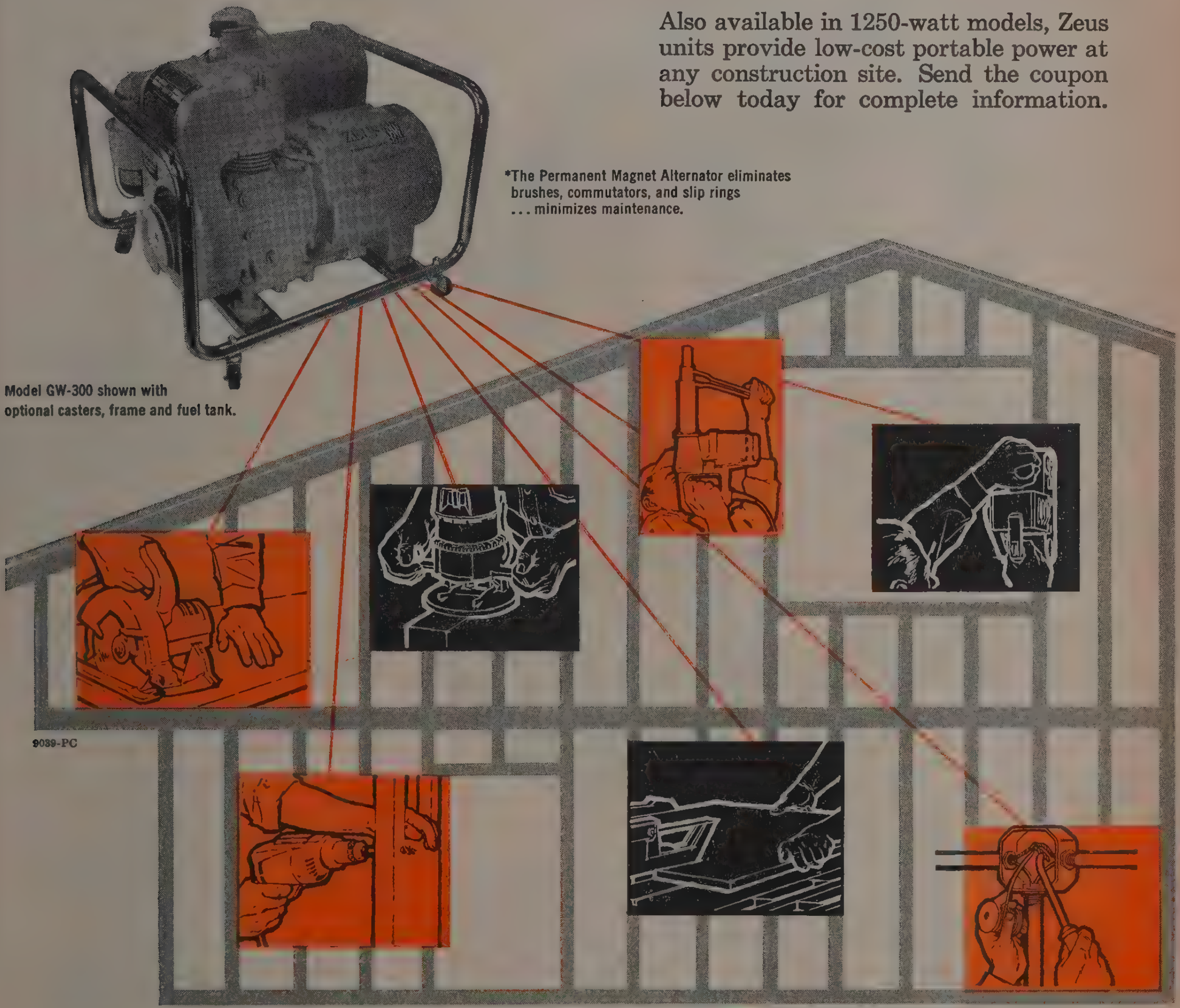
ZEUS

PORTABLE ELECTRIC GENERATOR

It's here! The new 3000-watt Zeus Portable Electric Generator now provides contractors everywhere with a *reliable* source of AC power . . . eliminates costly power-line installations . . . *pays for itself!* The job-proven Zeus features three fused outlets (115v & 230v) . . . dependable direct-drive gas engine . . . plus the exclusive Borg-Warner PMA* generator that *never wears out!* Lightweight Zeus generators deliver continuous full voltage for hours without overheating!

Also available in 1250-watt models, Zeus units provide low-cost portable power at any construction site. Send the coupon below today for complete information.



*The Permanent Magnet Alternator eliminates brushes, commutators, and slip rings . . . minimizes maintenance.

Model GW-300 shown with optional casters, frame and fuel tank.

9039-PC

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Please send me complete information about the following Zeus Portable Electric Generators ☐ 3000-watts ☐ 1250-watts.

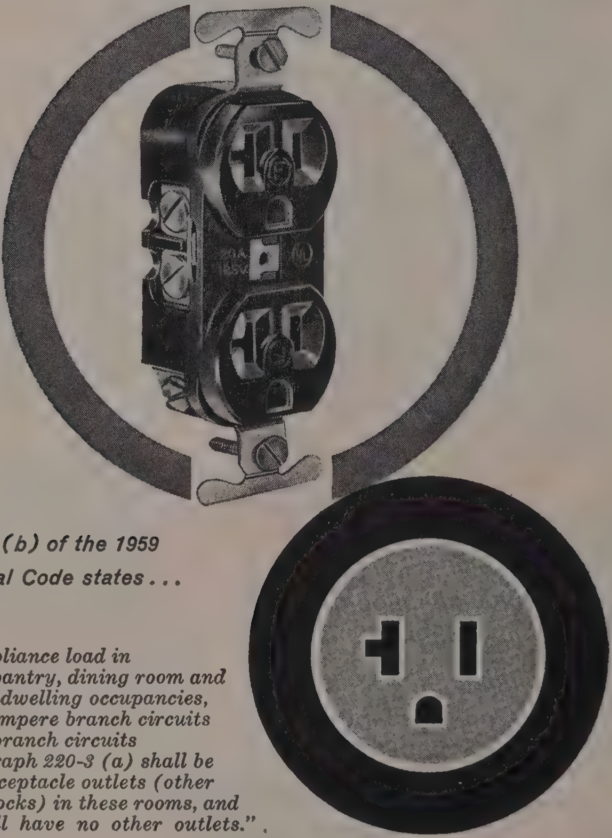
NAME__________TITLE__________

COMPANY__________

STREET__________

CITY__________ZONE____STATE_____

NEW
CIRCLE F
20-AMP
"U"-GROUND DEVICES



. . . Section 220-3 (b) of the 1959 National Electrical Code states . . .

"For the small appliance load in kitchen, laundry, pantry, dining room and breakfast room of dwelling occupancies, (1) 2 or more 20-ampere branch circuits in addition to the branch circuits specified in paragraph 220-3 (a) shall be provided for all receptacle outlets (other than outlets for clocks) in these rooms, and such circuits shall have no other outlets."

Designed to provide full compliance with the revised Code, Circle F's *new* No. 2532 does much more! It becomes a "universal" outlet! It accommodates appliances, heavy-duty portable tools, business machines, etc., having substantial energy requirements, where the new 20 A.-125 V. plug cap (No. 2528) is necessary. It also accommodates 15 A.-125 V. 3 wire U-ground and standard parallel blade caps. One outlet for all! Circle F's quality is tops and the price is right. Contact your Circle F representative for complete details.

GUARANTEED WIRING DEVICES

CIRCLE F MFG. CO.
TRENTON 4, NEW JERSEY

(84) **Pushbuttons.** Bulletin GEA-7127, 10 pages, describes complete line of industrial miniature oil-tight pushbuttons with dimensions, ratings, outlines and drawings. General Electric Co.

(85) **Load Box** bulletin SB-LB-1 lists numerous applications, outlines the design features of various models of the universal load box. Multi-Amp Division, Multi-Amp Electronic Corp.

(86) **Moldings.** A new catalog section KG describes complete line of plastic Kover-Gard moldings for protection of surface-mounted conductors and cables. The Fanner Mfg. Co.

(87) **Sound Systems.** A new illustrated brochure "Sound Systems for Schools" describes a complete line of communication and program systems for all school needs. Dukane Corp.

(88) **Rubber Insulation** for wire and cable. Characteristics of wire and cable insulated with Silastic brand silicone rubber are described in new booklet. Dow Corning Corp.

(89) **Transformers.** New bulletin 5800-1A, 16 pages, gives information on its custom-designed, liquid-filled substation transformers for use by utility, industrial and consulting engineers on this specific type of unit. I-T-E Circuit Breaker Co.

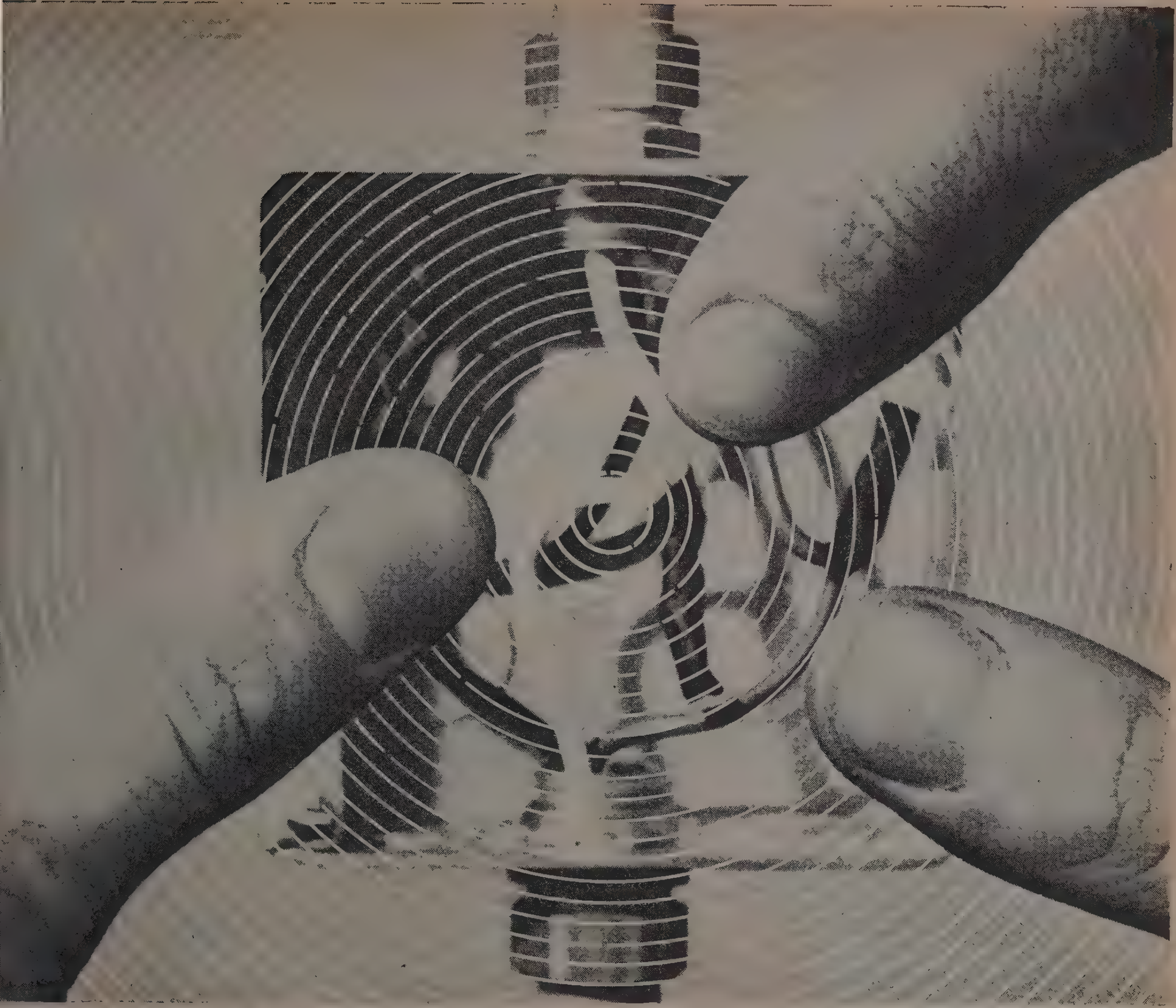
(90) **Cold Cathode Lamps.** Group replacement coupled with the use of cold cathode lamps have been found to provide maximum efficiency and minimum cost for large lighting installations is reported in "When Should Cold Cathode Lamps Be Replaced." Voltarc Tubes, Inc.

(91) **Heater.** Literature describes new "Infra-Mite" infratube heater line. Apextro Products Co.

(92) **Outdoor Lighting** is described in new 32-page catalog TP-2 including photographs, specifications and dimensions. Stonco Electric Products Co.

(93) **Electric Heaters.** Bulletin GEC-1005K, revised 48-page catalog, lists product and application data for Calrod industrial electrical heaters and devices. General Electric Co.

(94) **Power Supply.** High-current power supplies (ac/dc) and variable voltage transformers for laboratory and industrial use are described in 4-page brochure. Glenn Pacific Power Supply Corp.



Take the Thumbs Out of Electrical Wiring With Improved J-M Dutch Brand Plastic Tape

makes every job easier, faster, more economical

Johns-Manville Dutch Brand Plastic Electrical Tape is now made *even* better! With its improved adhesive, Dutch Brand accomplishes every wiring job with new time-saving nimbleness. Rugged, versatile, it has what it takes to stick around in the "tight spots"—conforming to irregular surfaces neatly without bunching. Important too, Dutch Brand Plastic is now packaged in money saving, economical, convenient 44-foot rolls in addition to the regular 20′ and 66′.

See why Dutch Brand Plastic is best for all your wiring assignments . . . Send for "Big Four in Electrical Tapes", the idea booklet that illustrates how you can do better electrical jobs.

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JOHNS-MANVILLE

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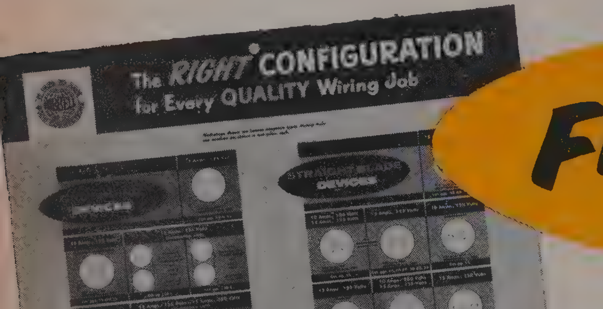
JM
PRODUCTS

announcing 2 new HUBBELL WIRING DEVICE FACT FINDERS . . .

to save you hours of catalog hunting



Free 11" x 17", 4-color Wall Chart, suitable for hanging.

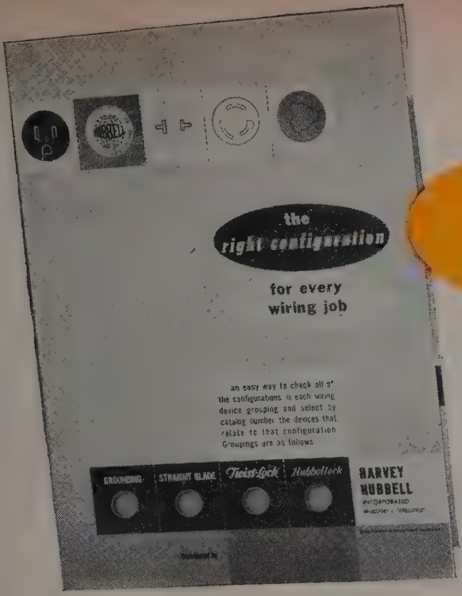
FREE CONFIGURATIO CHART

In seconds, you can find every known A.S.A. wiring device configuration on this color-coded, 11" x 17" wall chart . . . and it's yours absolutely free if you mail the coupon at right.

Alongside each female configuration is listed (1) its rating, (2) catalog numbers of typical matching caps and receptacles, (3) its page number in the Hubbell catalog.

Color blocks tell you quickly whether the configuration belongs to Grounding, Straight Blade, Twist-Lock, or Hubbellock categories. You'll wonder how you ever got along without it.

This same 4-color chart information is also available in catalog page size (8½" x 11", 3-hole punched), and like the big wall chart is absolutely free. Act now while the supply lasts.

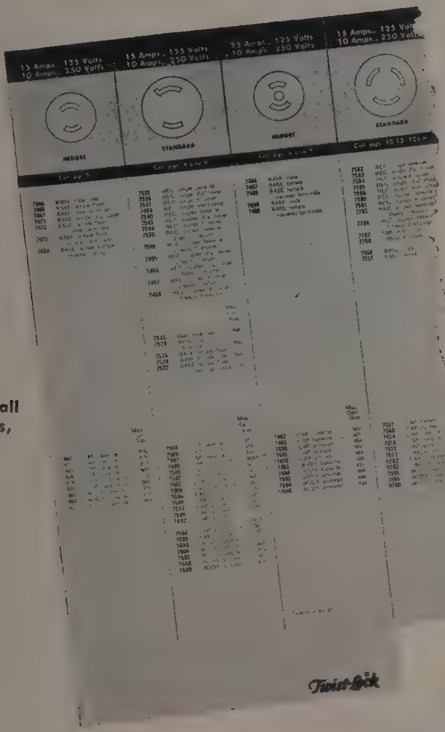

the right configuration for every wiring job

an easy way to check all of the configurations in each wiring device grouping and select by catalog number the devices that relate to that configuration. Groupings are as follows

GROUNDING STRAIGHT BLADE Twist-Lock Hubbellock

HARVEY HUBBELL INCORPORATED

4-color Selector Guide, color-coded for easy wiring device group identification, 16-pages spiral bound and mounted in attractive, heavy-weight varnished cover.



Ratings.

Configurations.

Pg. No's. in Hubbell Catalog.

Listing of all receptacles, caps and bases.

18-PAGE SELECTOR GUIDE

only 50¢

Here's another great time saver. In this handy, desk-sized selector guide, you can find all the related Hubbell wiring devices (caps, bodies or bases) made in each configuration—and it only takes a few seconds.
Here's how it works:

1. Four index tabs, color-coded to match your wall chart, quickly guide you to pages listing Grounding, Straight Blade, "Hubbellock" and "Twist-Lock" configurations.
2. Configuration diagrams and ratings at the top of each page guide you to the column you want.
3. In this column you find catalog numbers and brief descriptions of all receptacles, caps or bases made in this configuration, and their page numbers in the Hubbell catalog.

For example, note the typical page at left. Suppose you had a Hubbell 7544 2-wire "Twist-Lock" duplex receptacle and wanted to know what caps were available to fit it. Simply by locating the standard 2-wire "Twist-Lock" configuration in the "Twist-Lock" section you would find the 7544 and a listing of all the caps that fit it. And, if you needed detailed information about any of these items, the catalog page reference pages 8 and 9 at the top of the column would save endless hunting time.

At only 50¢ a copy, this guide will more than pay for itself in time saved and errors prevented. Our supply is limited. So tape two quarters or five dimes to the coupon below, enclose in envelope, and get your copy by return mail.

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☐ Send free Configuration Wall Chart. ☐ Send free Configuration Catalog Page
☐ Fifty cents enclosed. Send Handy Selector Guide postpaid to:

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Name________________________________

Company________________________________

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City____________________ State________

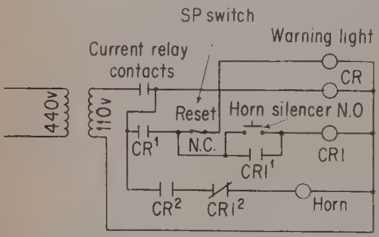
Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installations, maintenance and repairs. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

Pre-determined Overload Signal

QUESTION H38—What might be the most reasonable way of signaling on a machine before the magnetic switch trips under an overload condition? This should be accomplished before the tripping point so the feed to the machine could be reduced. I have used an extra heater block in the load circuit, which has a thermal heater of a smaller value than the ones in the magnetic switch. Then the contacts are reversed so they make contact as the load comes to a predetermined value. This causes the alarm circuit to be completed. The reset is made automatic by removing the catch so it will open the contacts as the load is decreased. Would like to hear of other methods used. —E.S.H.

ANSWER TO H38—Below is schematic of such a circuit as you request, which although is more elaborate than you desire, can be modified to suit your requirements.



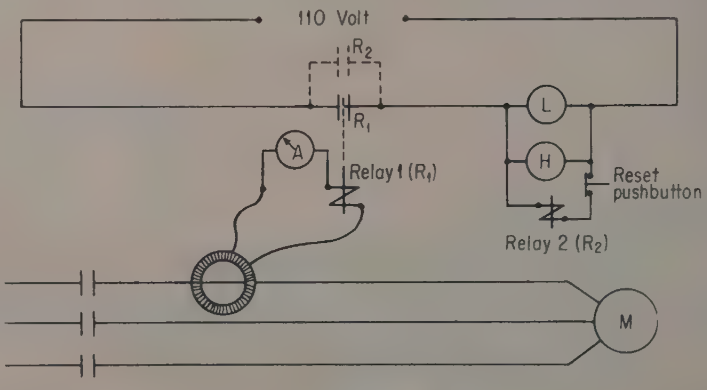
This system is controlled by a current relay, which is adjustable and much more accurate than on overload relay. When the current relay closes, relay CR operates and closes contacts CR^1 and CR^2, thus operating the warning horn and light. The horn silencer button is then pressed, silencing horn by energizing CR^1. The single-pole switch is used to turn off light in case overload is temporary.—E.T.

ANSWER TO H38—Selecting equipment suitable for signaling an impending overload relay trip would require an evaluation of: available equipment, type signal desired, visual, audio, adjustable or nonadjustable, adjustments accessible or concealed time lag between signal and overload trip, intensity and frequency and duration of overloads, coordination with existing or selection of new motor overload relays. Dependability and maintenance required should be given greater consideration than the cost of this type of signal system because a dependable circuit might be extended to stop and start the motor automatically for maximum production.

There are several manufacturers selling package units for such alarms. It is also possible to procure basic components and create a system with the desired features. An alarm might be assembled using any current-operated device sensitive to less current than the motor overload relays. Consideration should be given to: ammeters—indicating, recording, contact making, full-current or current-transformer type; current relays—magnetic, instant, short delay, long delay; thermal relays—manual or automatic reset.—C.R.K.

ANSWER TO H38—There are numerous devices on the market that will well satisfy your needs. One such device is a current-sensitive, instantaneous response that can be set to any predetermined value. It also has an ammeter in the circuit as a means of visual indication for continuous monitoring. They are usually self-contained, and all that is necessary to put into operation is to slip the inductor coil over one leg of the load circuit.

The current-sensitive relay and ammeter are in series with the inductor coil. The relay contact (R_1) is in series with a 110-volt supply and light and horn. It can be made self-latching as indicated by the dotted R_2 contact. Here the light will stay lit and the horn will blow until reset is pushed.—J.A.M.

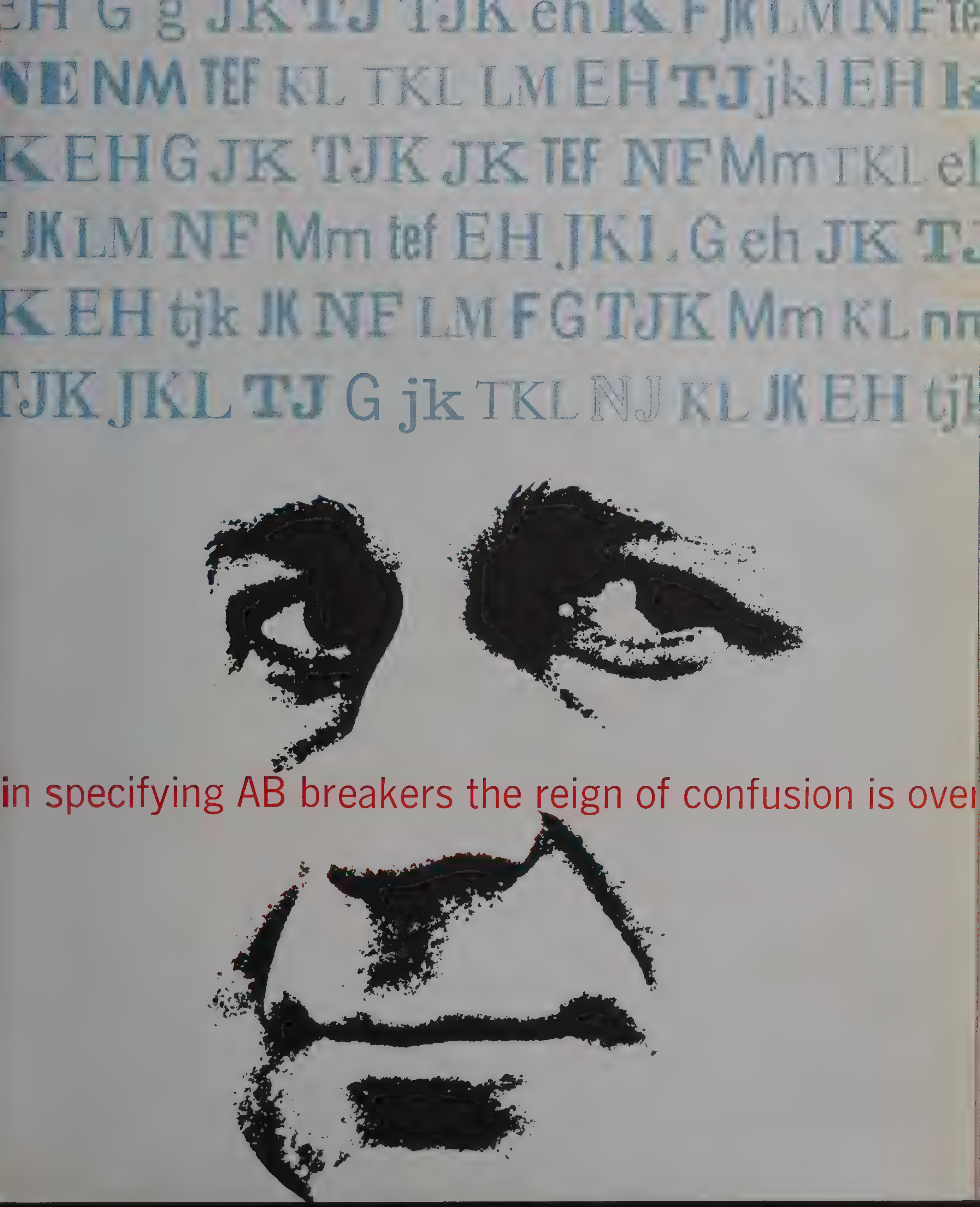


Editor's Note:—Where current relays are used, as indicated in the diagrams of two answers to Question H 38, one important fact should not be overlooked. If the motors involved are 3-phase, current relays should at least be installed in two phase conductors to the motor, particularly if the branch-circuit overcurrent devices are other than 3-pole, simultaneous-trip CB's. Otherwise, single phasing could occur, which would increase the line current of two phases while the third-phase current would be zero. And should a single current relay be connected to the open phase, the control circuit would not indicate a possible overload.

The diagrams submitted provide reasonable automatic operation. With a little thought, the circuits can be revised to include simple manual controls to replace much of the relay/contact controls. For example, manually operated SP switches could be used to disconnect the warning light and horn. This would involve considerably less cost. However, any non-automatic control is vulnerable to human error. And, unless machine operators and maintenance personnel are fully aware of the shortcomings of manual controls, automatic controls will prove to be less expensive in the long run.

Actually, the circuit described in E. S. H.'s question has proved to be effective in many installations and is widely used.

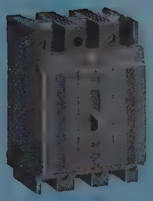
As with most questions of this type, answers can be given only in a general nature. But, when basic designs and ideas are expressed, they can be altered to satisfy a particular application.—J.H.W.


EH G g JK TJ TJK eh K F jk LM NF te
NE NM TEF KL TKL LM EH TJ jkl EH
K EHG JK TJK JK TEF NF Mm TKL el
JK LM NF Mm tef EH JKL G eh JK T
K EH tjk JK NF LM F G TJK Mm KL nn
TJK JKL TJ G jk TKL NJ KL JK EH tj
in specifying AB breakers the reign of confusion is over

Westinghouse completely redesigns its breaker line

SIMPLE TO SPECIFY/EASY TO IDENTIFY

Newly designed breaker line simplifies frame designations . . . reduces spac requirement up to 50%. Because of recent Westinghouse engineering advances, these ne breakers retain the same high interrupting capacities of older designs in smaller frame sizes. Th new designs mean it's easier for you to order, install and use AB breakers. Gone is the confusin assortment of letters that designate other models. These new breakers are easy to identify becaus they follow a common-sense sequence. They're simple to specify because you choose from on six breakers for virtually every application. They're better to use because they're smaller . . . ye you have the same quality and reliability of the former Westinghouse models you've been usin



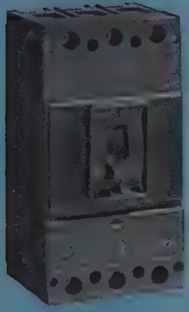
15-100 amps, 240 volts a-c,
125 volts d-c, 1, 2 and 3 poles
IR @ 240 volts a-c: 7500 amps

FA

15-100 amps, 600 volts a-c,
250 volts d-c, 2 and 3 poles
IR @ 240 volts a-c: 20,000 amps
Replaces: EH, F and G breakers
Check Westinghouse for availability
of this newest breaker.

JA

70-225 amps, 600 volts a-c,
250 volts d-c, 2 and 3 poles
IR @ 240 volts a-c: 25,000 amps
Replaces: J breakers



KA

70-225 amps, 600 volts a-c,
250 volts d-c, 2 and 3 poles
IR @ 240 volts a-c: 30,000 amps
Interchangeable Trip
Replaces: JK and K breakers

LA

125-400 amps, 600 volts a-c,
250 volts d-c, 2 and 3 poles
IR @ 240 volts a-c: 50,000 amps
Interchangeable Trip
Replaces: KL and JKL breakers

MA

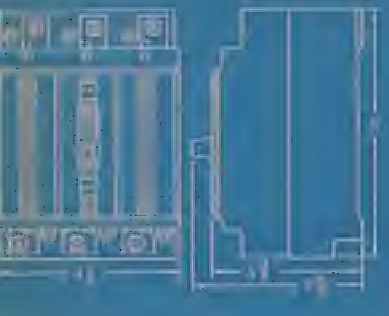
125-800 amps, 600 volts a-c,
250 volts d-c, 2 and 3 poles
IR @ 240 volts a-c: 50,000 amps
Interchangeable Trip
Replaces: L, M and LM breakers

IR = Interrupting Rating

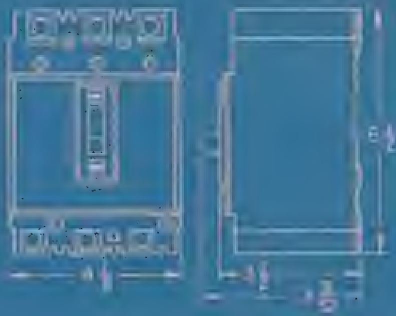
Add the fact that terminals accept either copper or aluminum cable. Any way you look at it, the
EW Westinghouse line is the one you'll want to use from now on. • Want more information on
is new line of breakers? Contact your Westinghouse representative, Westinghouse distributor,
earest independent panelboard-switchboard builder, or write Westinghouse Electric Corporation,
tandard Control Division, Beaver, Pa. • We're offering a free wall chart that shows the new line
f breakers. It measures 17 x 22 inches, is plastic coated and gives dimensions, interrupting ratings,
aximum amps and volts and, of course, the newest designations along with the breaker photos.
rite to the Westinghouse address above for your copy.

ll Westinghouse AB breakers meet or exceed NEMA and UL specifications.

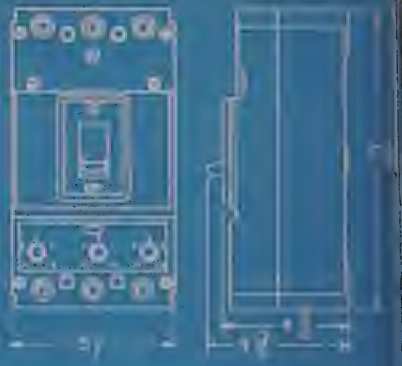
new breakers / new sizes / new designations



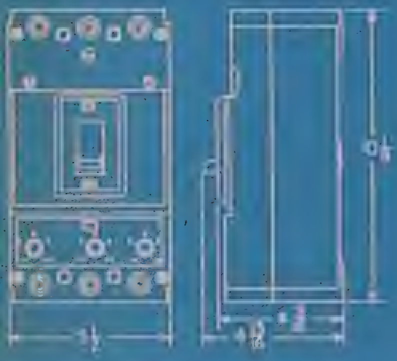
E 15-100 amps, 240 volts a-c,
IR @ 240 volts a-c: 7500 amps



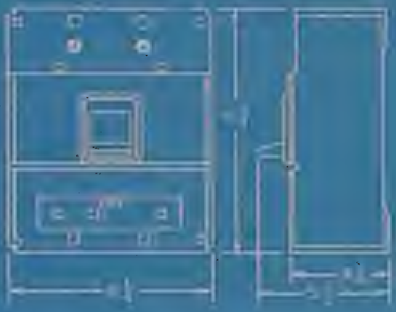
FA 15-100 amps, 600 volts a-c,
IR @ 240 volts a-c: 20,000 amps



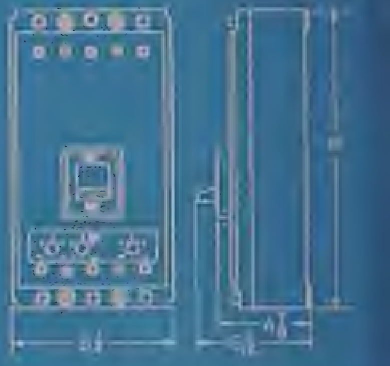
JA 70-225 amps, 600 volts a-c,
IR @ 240 volts a-c: 25,000 amps



KA 70-225 amps, 600 volts a-c,
IR @ 240 volts a-c: 30,000 amps



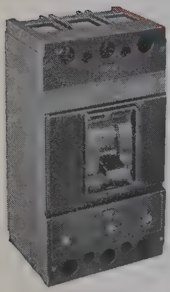
LA 125-400 amps, 600 volts a-c,
IR @ 240 volts a-c: 50,000 amps



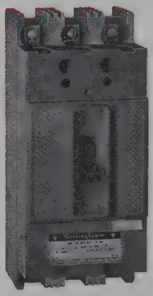
MA 125-800 amps, 600 volts a-c,
IR @ 240 volts a-c: 50,000 amps

IR=Interrupting Ratir

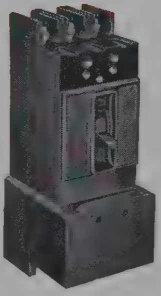
a Westinghouse breaker for every application



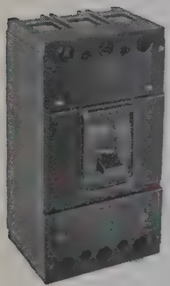
SAF-T-VUE* . . . lets you see whether the contacts are open or closed. Fills the needs of every industrial plant where safety codes require visible contacts. All frames.



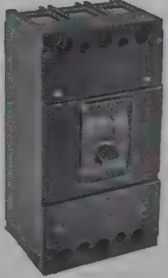
MARK 75* . . . interrupts up to 75,000 amps at 240 volts a-c. Costs a fraction of conventional high interrupting capacity breakers. Does not require reactors or fuses, is particularly suited for network systems.



TRI-PAC* . . . smalles
lowest cost protecti
device you can app
where 100,000 amps ca
be poured into faults. E
ample: network systen
or those fed by larg
transformers.



THERMAL MAGNETIC . . . provides instantaneous opening on short circuits, yet permits harmless momentary overloads such as those encountered in motor starting and initial lighting surges. On sustained overload, the higher the current, the shorter the opening time. All frames.



AMBIENT COMPENSATED . . . ends nuisance tripping, and eliminates need for derating where elevated or changing temperatures are encountered. All frames.

MAGNETIC ONLY . . . pr
vides short circuit pr
tection only. Primari
used on motor circui
where overload prote
tion is provided by oth
means. All frame size
except E.

WESTINGHOUSE ELECTRIC CORPORATION Standard Control Division, Beaver, Pa.

*Trade-Mar

Printed in U.S.A.

JI-303

Testing CB Oil

QUESTION J38—We recently experienced a major short circuit on our 4160-volt distribution system and the short was cleared by an oil circuit breaker. We suspected that the oil had become damaged by the extensive arc, but we had no effective means of testing this oil.

Has anyone had any experience with short circuits similar to this? How does one go about testing this oil? And finally, can the insulating properties of the oil be destroyed by an arc?—J.A.M.

ANSWER TO J38—A major short circuit certainly never helps an oil breaker of any rating. When it appears that the oil has picked up color, carbon or copper, from any fault operation, it should be tested after treating it to at least remove suspended foreign matter. Copper can be seen as can carbon. Most of this is caused by interrupting an arc with the breaker, the carbon from the oil, and the copper from the contacts of the breaker.

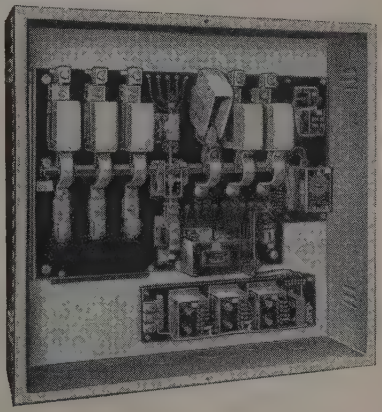
The breaker mechanism and contacts should be examined at least once a year. The condition of the oil, since age can also cause sludge and increasing damage in an interruption such as you describe, should also be noted. If sludge or suspended matter is present, the oil should run through a blotter press at least, and possibly checked for acid, although at up to 5 kv rating at least, a blotter press is usually enough to cause the test to come up to 30 kv for ten seconds or so. This will give safe operation. Of course, if oil took much of a "shot" it is probably cheaper to replace the oil with new. For safety, this should be removed from a full barrel, sealed to make sure that moisture has not been absorbed in this oil also. It is not at all foolish to give this barrel, if it has been opened and is a part barrel, a dielectric test as previously described. This test is performed on a standard dielectric tester, which consists of a practical means of getting a high voltage of at least 30 kv across electrodes in a standard sphere in which the oil can be poured. The electrodes are tipped with 1-in. discs that are spaced at $\frac{1}{16}$ of an inch. A means of gradually increasing the voltage should be provided. If 60 kv can be attained, so much the better. But for the rating you speak of, 30 kv will be satisfactory.

Aside from checking oil dielectric on the yearly checks, the mechanism and contacts of the breaker should

ZENITH

AUTOMATIC TRANSFER SWITCHES...
engineered to assure continuous power, safeguard life, property, production.

MAGNETIC CONTACTORS...
reliable power switching, rugged durable design.



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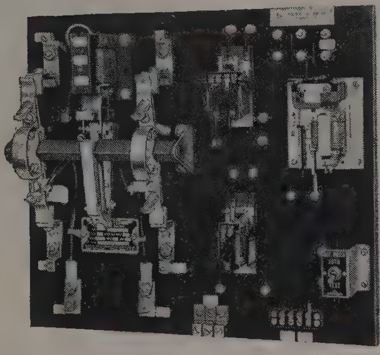

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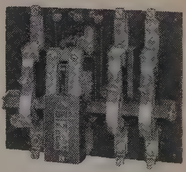

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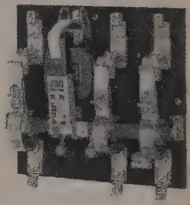

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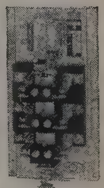

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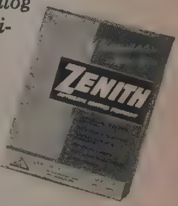

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be serviced according to the factory requirements of this breaker and any other breaker on your system. Whenever the breaker trips for any reason not within the normal service procedure, oil can be "spoiled" dielectrically by an arc. Good oil when poured from one container to another has a "rainbow" hue.—J.W.L.

ANSWER TO J38—The July issue of *Electrical Construction and Maintenance* which carried J.A.M.'s question regarding damage to the insulating oil of an oil circuit breaker also carried an article entitled "Circuit Breaker Oil-Tests and Maintenance" by C. Feldman of Allis-Chalmers. In this article, Mr. Feldman discusses several field and laboratory ASTM tests which are made to determine the condition of the insulating oil. It would appear that J.A.M.'s questions should be adequately covered when he reviews this article and the listed ASTM tests.—R.G.W.

ANSWER TO J38—All electrical insulating and cooling oils decompose with age. The decomposition is accelerated by service and high temperatures. The normal life of the oil is about 15 years. The oil decomposing absorbs oxygen and forms organic and inorganic acids, sludge and water. Filtering will normally remove sludge and water and slightly reduce the acid number. However, excessive filtering, more than every three to five years removes the natural inhibitors that retard decomposition and reduce oil life results.

The quality of any insulating oil in service is measured by two tests, (a) dielectric strength, (b) acid numbers.

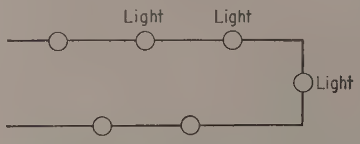
(a). If the dielectric strength is below 22,000 volts, as determined by standard test, the moisture content is high and the oil should be filtered.

(b) If the acid number is above 0.60, as determined by test, the oil is deteriorated to a point at which it should be discarded.

Note: Acid number of an oil is the number of milligrams of KOH to neutralize one gram of oil sample.—L.R.S.

Underground Fault Locator

QUESTION K38—I have a 6.6-amp constant, current series, street, lighting system with three separate circuits. The cable used is a single conductor of the direct-burial type. On one of these circuits, there now exists more than one ground, which I have been unable to locate. The cable layout in this circuit requires two single conductors running in the same ditch as per drawing:



This method of laying the cable has rendered the use of my fault locator useless for one cable cancelled out the other.

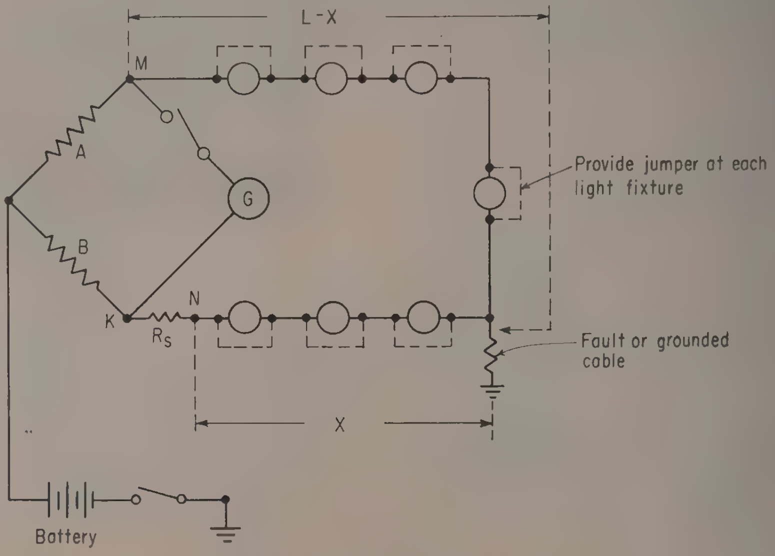
How can I pinpoint these grounds?—J.F.

ANSWER TO K38—The question is raised as to how to locate grounds. In the system shown, if the power can be temporarily removed from the system, and a source of let us say 1,000-cycle tone fed into the cables, then there will be a sharp diminution in tone as one passes over a ground. There are a number of these cable-flaw detectors available today.—H.H.S.

ANSWER TO K38—J.F. is not clear just how the three separate circuits are connected. I will assume that they are in parallel and connected across a constant-current transformer. Since the circuits are for series street lighting, I would suggest the following:

1. At each light make a solid connection, as shown, to eliminate the lamps and/or transformers.
2. Connect the individual circuits to obtain the equivalent of the well known Varley loop. (see sketch.)
3. Determine the resistance of each circuit from the resistance per foot of cable used. The distance between the street-lighting fixtures should be accurately measured. A lower measured resistance of the cable would indicate more than one ground.
4. Determine the ratio of L-X to X + Rs and solve for the resistance X. Calculate the distance "X" from resistance per foot of cable.
5. Measure this distance off on the ground, taking into consideration the length of cable to top of lighting fixture and the amount of slack cable in the fixture.

If two or more solid grounds are on the same circuit, the lights between these grounds would be shorted out. A high-resistance ground short would merely reduce



L = Total length of cable

A & B = Wheatstone bridge resistance

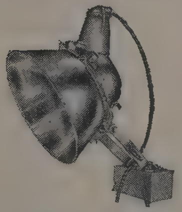
(G) = Galvanometer

R_s = Bridge balancing resistance

X = Distance in feet to fault measured along route of buried cable. (Measured as ohms and distance determined from resistance per foot of wire used in lighting cable.)

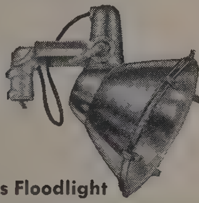
Formula:

$$\frac{A}{B} = \frac{L-X}{X+R_s}$$ When galvanometer is balanced



2000 Series Floodlight

3800 Series Floodlight



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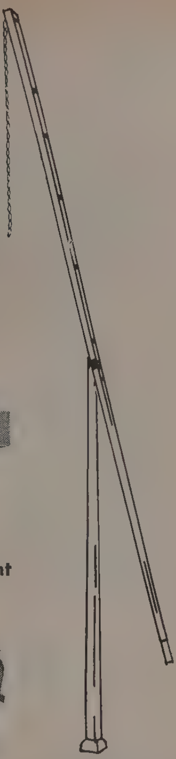

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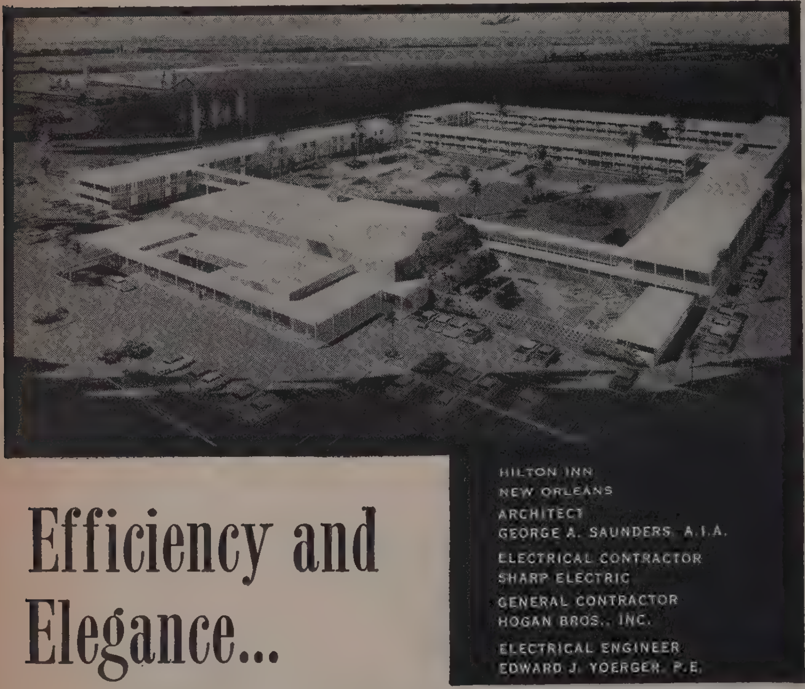

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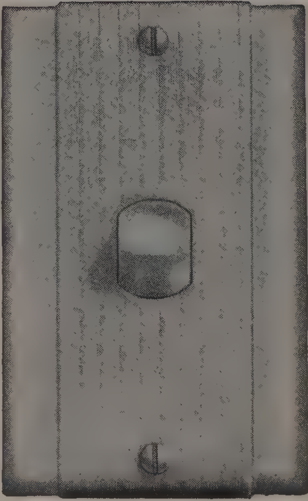

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the voltage on the lamps between the grounds.

There are several ground locating devices on the market; however, these are not always practical because of their many physical limitations imposed upon their use. With a little ingenuity such as, opening up the cable circuit at each lamp and checking to ground, I am sure J.F. will be able to locate the grounds on his cable.—H.E.H.

Can You Answer These QUESTIONS?

QUESTION T38—We have a question about battery-operated fork lift trucks. In changing from one type to another, space is a limiting factor.

What happens if we change from a 36-volt battery to a 32-volt battery in a fork lift truck originally designed for 36 volts? Will the motor draw more current under normal load, therefore requiring a battery of larger capacity? Will there be any gain whatsoever in changing from a higher voltage-lower capacity to lower voltage-higher capacity?—J.A.M.

QUESTION U38—On a 115-volt air conditioner unit where or what would generate 220 volts across the starting relay coil? It is a $1\frac{1}{2}$-hp unit with load amps of 10.4. When plugged into 115-volts it draws 7 amps with 220 volts across the relay. When the starting circuit wire is removed from the compressor while running, the voltage drops to 115 volts across the coil and the amps go up to 10.

The unit consists of a compressor, fan motor, starting relay, 15 MF running capacitor, and an electrolytic capacitor.—C.H.

QUESTION V38—I understand that a perfectly balanced fluorescent lighting load fed by a 3-phase, 4-wire system will have current flow in the neutral. How can I calculate the magnitude of this neutral current in order to choose the size of the neutral? How will this neutral current affect the voltage-drop in the feeders?—H.M.

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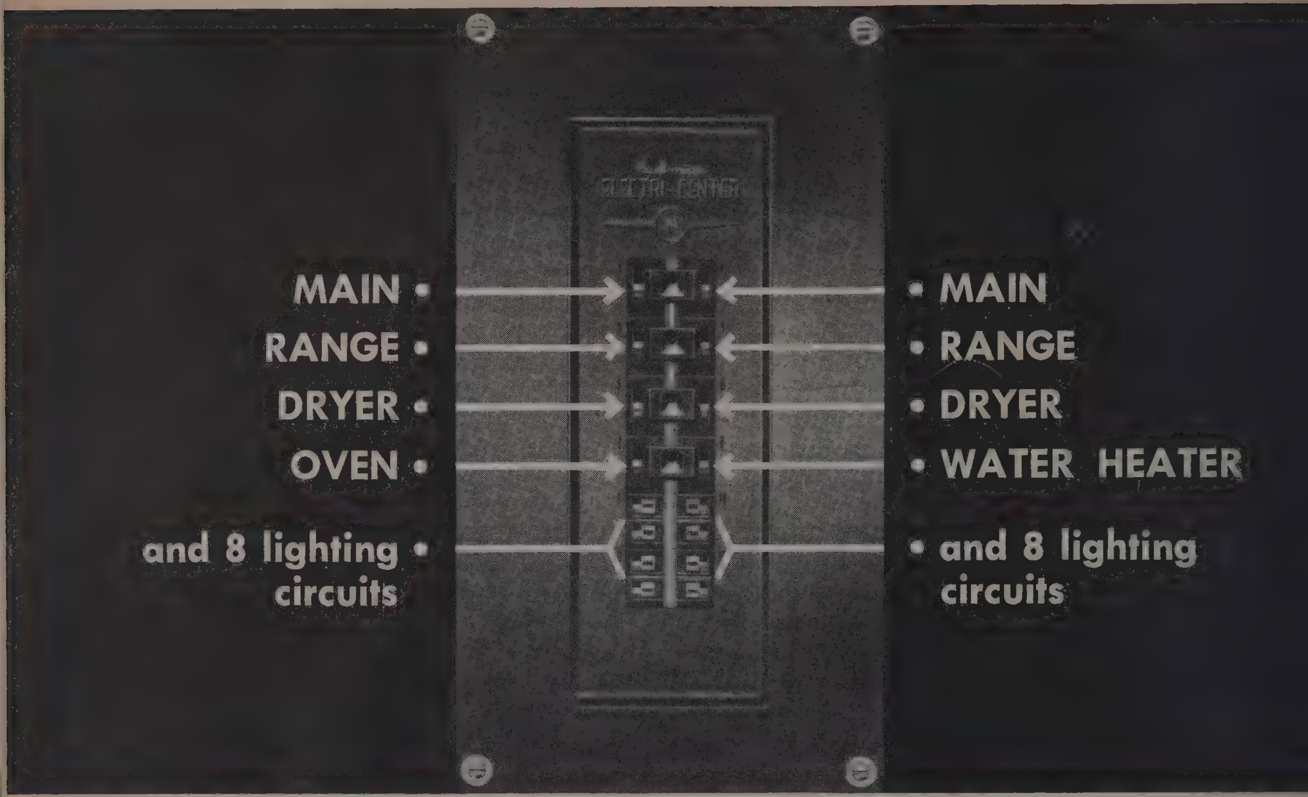

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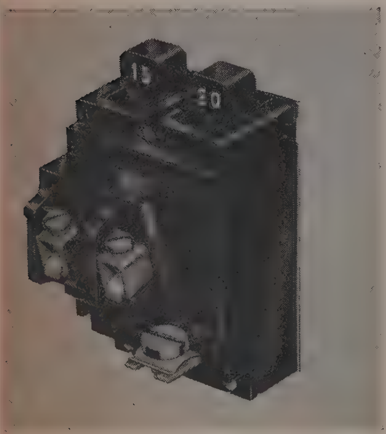

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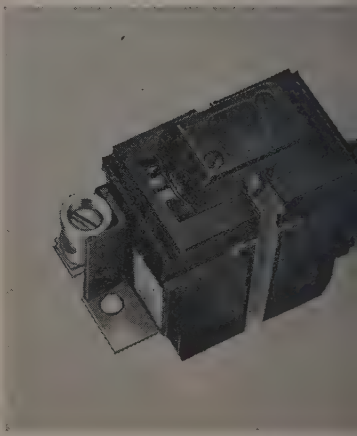

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Questions on the Code

Answered by:

B. A. McDONALD, *New York Board of Fire Underwriters, Rochester, N. Y.*
B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*
R. E. WARD, *Chief Electrical Inspector, Insurance Department, State of Tennessee, Nashville, Tenn.*

Flexible Conduit-Voltage Limitation

Q. *Does the NEC limit the use of flexible conduit for circuits of 600 volts or less?*

I am referring to several sections of the code. Article 350, to start with, states: "Installation of flexible metal conduit shall comply with the provisions of appropriate (or applicable) provisions of Article 300."

Section 300-2 makes what seems like the limitation, if applicable.

I also would like to call your attention to Section 710-3, which concerns voltage over 600. Is the flexible metal conduit considered part of the conduit system under the latter rule?—V.W.C.

A. Article 350, under Chapter 3 of the code, recognizes flexible metal conduit as a wiring method, subject to the provisions of Article 300. Section 300-2 of this Article is quoted as follows:

"300-2. Voltage Limitations. Wiring methods specified in Chapter 3 may be used for voltages not exceeding 600, unless specifically limited in some Articles of Chapter 3. They may be used for voltages over 600 where specifically permitted elsewhere in this Code."

The provisions of Section 710-3 of Article 710 cover the wiring methods that are considered to be suitable when the voltage exceeds 600. It is quoted as follows:

"710-3. Wiring Methods. Circuit Conductors shall be suitable for the voltage and the conditions under which they are installed. They shall be installed in rigid metal conduit, in raceways or ducts, or as open runs of metal armored cable suitable for the use and purpose.

"Exception. In locations accessible to qualified persons only, open runs of non-metallic sheathed cable, bare conductors and bare bus bars may also be used."

It appears evident from the foregoing that flexible metal conduit, for general use, cannot be used when the voltage exceeds 600, and it is likewise significant to note that metal armored cable may be so used. Section 710-2, however, recognizes exceptions to this fundamental rule by reference to **installations covered in other articles.** As an example, reference is made to Articles 410 and 600. Section 410-86 covers the wiring method considered suitable for electric-discharge lighting systems of more than 1,000 volts. This rule requires approved gas-tube sign cable suitable for the voltage of the circuit to be used, and further advises that the method of installation is covered by Section 600-31. This latter Section of the code pertains to "Signs and Outline Lighting-Exceeding 600 Volts." This rule is quoted as follows:

"600-31-(a). Wiring Methods. Conductors shall be installed as open work, as concealed conductors on insulators, in rigid or flexible metal conduit, or in electrical metallic tubing."

While the code denies general use of flexible metal conduit when voltages exceed 600, the foregoing exceptions under Articles 410 and 600 recognize such use for a specific purpose.—B.A.McD.—10/60/1

CODE
COMMENT

Our lead editorial, "Low-voltage for Pools," on page 87 of our September issue called for speedy code action on the home swimming-pool lighting problem. The following are excerpts from a letter pertaining to the editorial.

"Mr. Buford H. Martin has been appointed Chairman of the Subcommittee on Underwater Swimming-Pool Lighting of the National Electrical Code Committee. Mr. Martin is with the Tennessee Valley Authority at 417 Edney Building, Chattanooga, Tennessee, and I am sure that he would be most appreciative of any information which can be furnished his committee regardin problems on swimming-pool lighting.

"The appointment of this Subcommittee came as a result of action initiated at the meeting of the Southwestern Section, IAEI, last year, where this problem received considerable attention.

"Mr. Martin's committee is attempting to secure information wherein fatalities have been experienced as a result of swimming-pool lighting, and I am sure any further information along this line, which you might have, would be most helpful to his group.
Baron Whitaker, Vice Chairman,
Electrical Section, NFPA"

Service-Entrance Cables in Parallel

Q. *Service-entrance cable is now being made in sizes larger than 1/0.*

The code permits 1/0 and larger cables to be run in parallel. Does this apply to service cables?—C.G.B

A. It would seem that such construction would be permissible provided all requirements of Section 310-10 are satisfied.—B.Z.S.—10/60/2

Heater Thermostats as Disconnects

Q. (1) *It is our understanding that a single-pole "positive-off" thermostat is acceptable in the State of Tennessee for use on portable electric 240-volt heaters. Is this correct?* (2) *We also understand that a double-pole "positive-off" thermostat is required on wall-insert 240-volt electric heaters. Is this correct?—V.B.*

A. A portable heater's supply is by cord with attachment plug in practically all cases. A means of disconnect is provided in a case of this kind by the use of the attachment cap and receptacle, and in such case, no other means of

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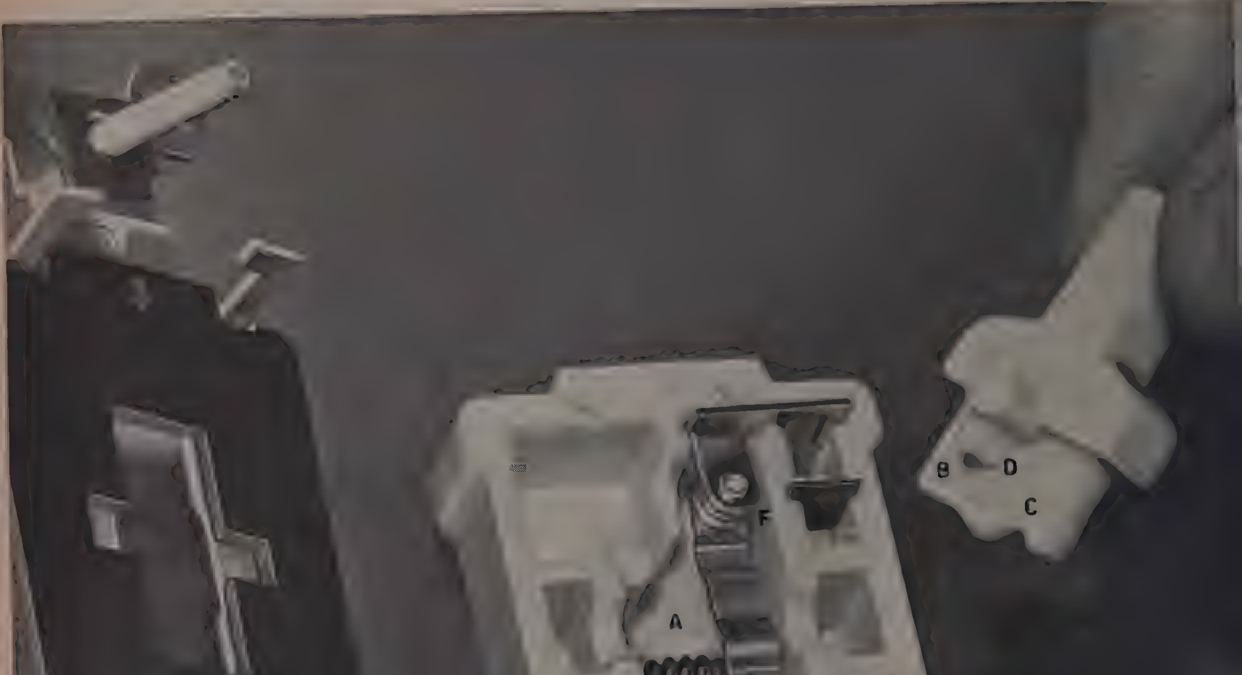

1. Notice there are no "bumpers" of elastic material, such as those used in other a-c switches to quiet noisy toggle actions. Bumpers make switches noisy when they harden with age.

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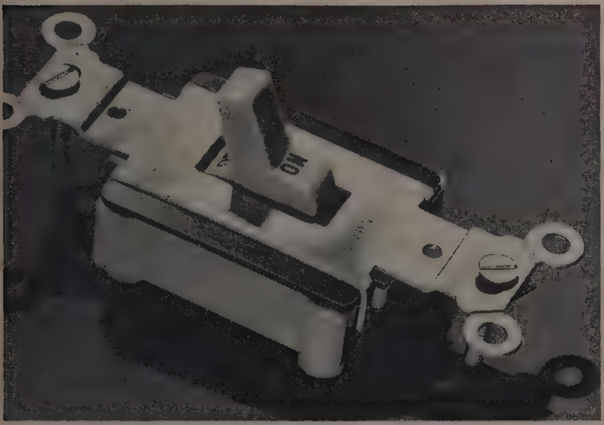
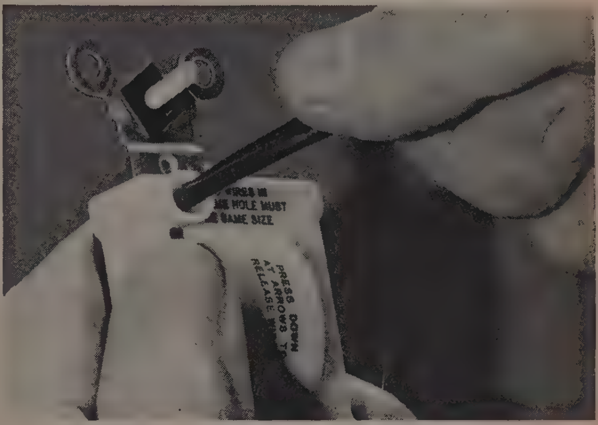


2. **See the special, arc-resistant construction.** The body of this switch is non-tracking, urea-base plastic — that resists charring and won't support arcing the way ordinary phenolic plastics sometimes do. Its heavy-gauge mounting strap is colored gold, to show you at a glance that this is a 20-A switch.



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4. **Note the increased safety you get, too.** Back-wired, Pressure-Lock connections don't work loose under normal vibration, temperature changes, or when you push the switch into the box. Cam action keeps its grip on the wires. Pressure-Lock terminals are also totally enclosed, to protect against grounds and shorts.

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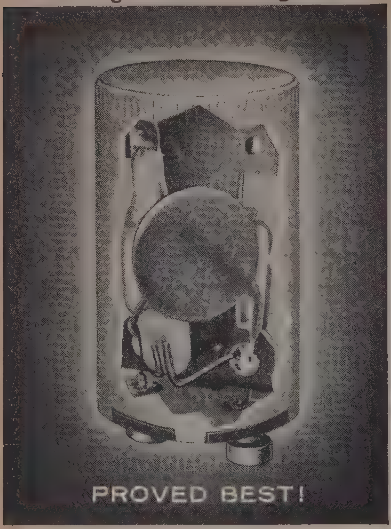

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disconnect is required. As an example, the user of the portable electric heater has fuse-protected equipment. The branch circuit, supplying the portable heater, is run from the plug fuses to the receptacle outlet where the portable heater is located, and, by disengaging the cord of the portable heater from the receptacle outlet, the appliance is disconnected. This is all that is required.

In answer to the second question, wall-insert heaters are usually permanently wired in, and it is a requirement that each ungrounded conductor have an approved means of disconnect. Therefore, if the thermostat is to be used as a means of disconnect, such thermostat would have to be according to Section 422-29, which reads:

"Controllers and Disconnecting Means.

(a) Thermostats and thermostatically controlled switching devices which indicate an "off" position and which interrupt line current shall open simultaneously all ungrounded conductors in the "off" position.

(b) Thermostats and thermostatically controlled switching devices which do not have "on" or "off" positions are not required to open all ungrounded conductors.

See Sections 422-14, 422-16 and 422-18 for disconnecting means for stationary appliances.

(c) Switching devices consisting of combined thermostats and manually controlled switches which serve both as controllers and disconnecting means shall:

(1) Open regardless of temperature all ungrounded conductors when manually placed in the "off" position;

(2) Be so designed that the circuit cannot be energized automatically after the device has been manually placed in the "off" position."

In reference to the first question, if a portable wall heater, rated 240 volts, did not have an approved means of disconnect other than the single-pole thermostat, the single-pole thermostat would not be an approved means of disconnect, and I point out that there are other approved means of disconnect. In residential occupancies, under certain conditions, the main service switch may be used as an approved means of disconnect. From my viewpoint this is not desirable, and in our State other means of disconnect are required other than the main-line switch for heaters and appliances.—R.E.W.—10/60/3

Grounding Receptacles in Bathrooms

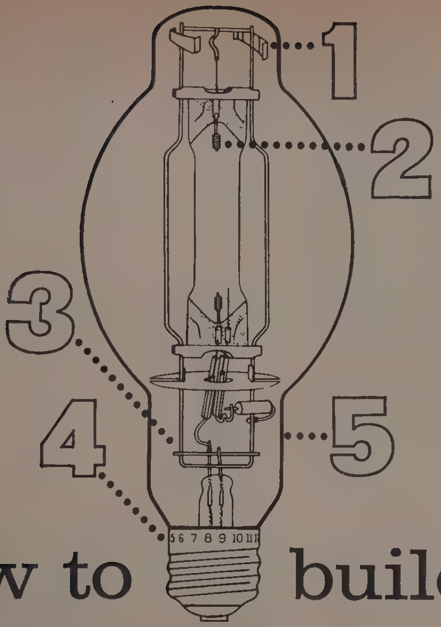
Q. *Section 210-22 (b) of the NEC requires grounding-type outlets in particular areas and ". . . in like locations where the outlets may supply equipment used by persons standing on the ground or on grounded conductive materials." Bathroom lighting fixtures, containing receptacles for electric shavers, evidently are not required by UL to have grounding-type receptacles even though heaters, lamps, shavers and other devices are habitually supplied from those receptacles. Does not Section 210-22 (b) require grounding receptacles in bathrooms? If so, do you contemplate any action by the Underwriters' Laboratories, Inc., in the future toward approving only bathroom lighting fixtures with grounding receptacles?—K.W.K.*

A. For the convenience of our readers, the pertinent provisions of Section 210-22 (b) read as follows:

"Only grounding-type outlets shall be installed in laundry rooms, open porches, breezeways, basements, cellars, work shops, garages, on the exterior surfaces of outside walls or in like locations, where the outlet may supply equipment used by persons standing on the ground or on grounded conductive materials."

It is significant to note that conductive locations such as bathrooms and kitchens are omitted, and I believe it would be very difficult to distort the above quoted rule to include such rooms of a dwelling occupancy. In fact, Panel No. 2, when formulating the new Section 210-22 (b), included bathrooms and kitchens as sponsored by some Sections of the IAEI, but Panel No. 5 exerted their influence to delete any reference to these rooms on the following basis: "Because there has been little evidence of hazard that would be reduced by the use of grounding-type receptacles." (See NEPJA No. 70 PR- 1958, page 48.) As a member of Panel No. 5, I disagreed with this concept of the hazard in such conductive locations as a kitchen or a bathroom.

In view of the foregoing, it appears obvious that this revised rule does not require grounding-type outlets in a bathroom or a kitchen. Such being the case, I do not contemplate any action in the immediate future which would influence Underwriters' Laboratories to re-



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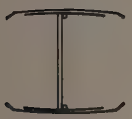
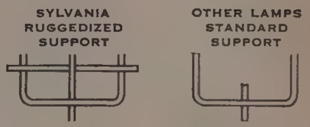
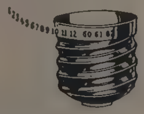


1 Built-in "Shock Absorbers." Top-lown view of Sylvania Ruggedized Dome Support shows tough double-leaf prings. They absorb shocks, vibrations, naintain correct position of arc tube. Even under roughest wear, Sylvania Mercury Lamps keep burning bright.

2 Brighter, faster lighting . . . even at 20°F. below! New Sylvania Trimetallic Electrode construction gives maximum protection, best performance, more light, longer life than any other mercury lamp! Sylvania Lamps start even in dead of winter!



3 Welded twice-over strongly . . . *that's* support! Other lamps balance the arc tube on a single welding. If it breaks, good-bye, lamp! Sylvania Ruggedized Base Support has *two* weldings. Result: *more* strength against shocks, vibrations. Longer life with Sylvania!



4 Bookkeeping done right on the base! Time-saving, moneysaving idea here! Sylvania Light Recording Base lets you scratch numbers on base representing month, year of installation. With 12,000-hour average rated life, Lamp tself tells how long it's lasted!

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6 Sylvania Light Insurance Policy states: "Provided it has not been physically or electrically misused, any Sylvania Standard Mercury Lamp may be returned to the supplier for full exchange if it fails in less than 100 burning hours; and for *pro-rata* exchange against its published rating if it fails between 100 and 4000 burning hours, provided adequate records are maintained to establish actual burning hours, in which case exchange will apply to the nearest 500 hours."

Sylvania Lighting Products, a Division of Sylvania Electric Products Inc., Dept. 15, 60 Boston St., Salem, Mass. In Canada: Sylvania Electric (Canada) Ltd., P. O. Box 2190, Station "O," Montreal 9.

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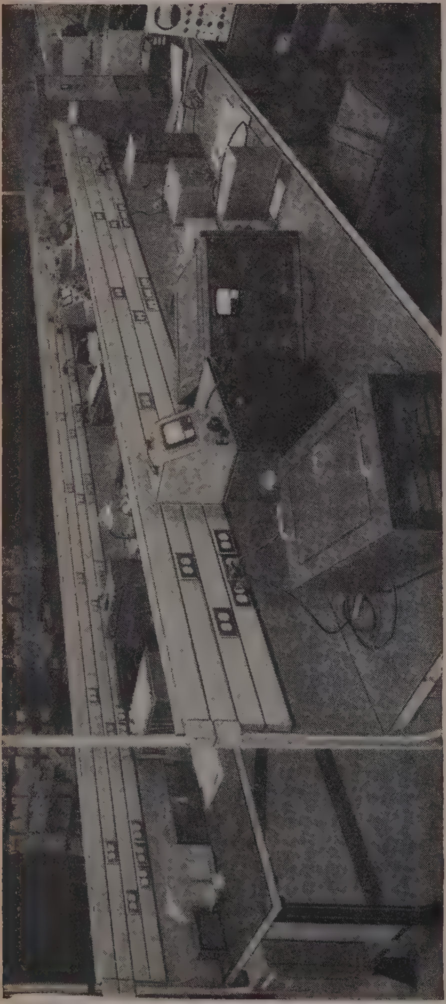

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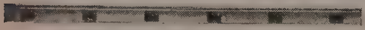

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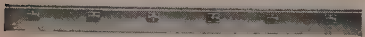

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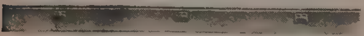

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EO-10

quire a grounding-type receptacle integral with a bathroo lighting fixture, regardless of the fact that the principal objective i to serve an electric razor.

Field experience over severa years indicates that the persona injury hazard involved with the us of an electric shaver has been minimized by insulation. When this electrical appliance first appeared o the market, UL and the manufacturers faced the responsibility fo its safe use in a conductive location They realized that a person in contact with a plumbing fixture woul be exposed to shock when a faul occurred on the razor. The very lif of this appliance, as well as tha of the person using same, depende upon a construction which woul minimize the shock hazard, and fiel experience indicates that the objective desired has been satisfie by insulation.

It is also significant to note tha even if Section 210-22 (b) did require a grounding-type receptacle in a bathroom, the provision of Section 250-45 (c) covering th grounding of portable equipmen in a residential occupancy would no require the grounding of equipmen connected to such a receptacle.— B.A.McD.—10/60/4

Fixture Fusing

Q. *In order to prevent unnecessary interruption, would i not be satisfactory to fuse all ballasts of fluorescent fixtures at thre amps?—M.D.*

A. You would not necessaril fuse fluorescent fixtures t prevent unnecessary interruptions Basically such fusing is installed t protect against any personal hazard or damage to property in th event of a breakdown in the fixtur ballast.

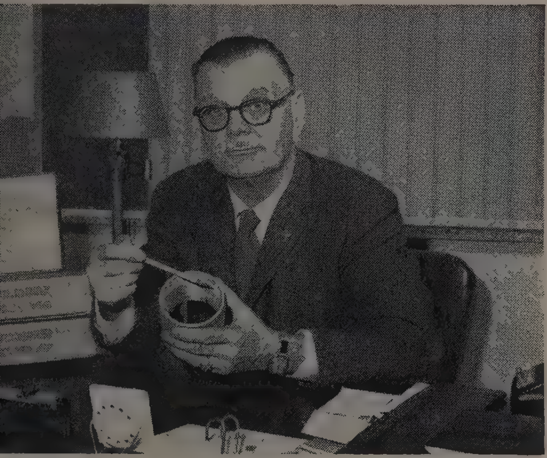
The ballast can fail for any on of the following reasons:

1. Improper installation
2. Ballast overheating due t lamp failure
3. Shorted capacitor
4. Shorted ballast coil or coils

If individual fusing is required— and at present such protection i not required by the code—the manufacturer of the ballast equipmen should be consulted. Different ballasts require different sizes an types of fuses for proper protection. Installing 3-amp fuses of an type will not offer proper protectio in all cases.—B.Z.S.—10/60/5

I'm H. G. Millican, President of Millican Electric Company, Atlanta, Georgia. The people at SPANG asked me my opinion of SPANG Conduit Couplings. We've used them years—almost exclusively—on electrical jobs in our area, there are a number of reasons why.

2 Most important from an installation viewpoint is the fact that the conduit will butt in the coupling—not just most of the time, but always. This butted joint leaves no slot for the snake wire to catch in. Makes wire pulling smooth. No time lost trying to unsnag hook ends.



SPANG quality is invariably high. Threads are clean and uniform—no burrs or snags to bind the conduit. In fact, can run couplings on the conduit by hand. Practically a hine fit. Try it and see! It means the coupling is straight. is another time-saver on the job.

4 SPANG Couplings are *double*-galvanized. First the conduit stock is hot-dipped — then the finished coupling is electro-galvanized. Now this means there is no metal-to-metal contact of coupling and conduit. No galvanic action. Instead, it forms a strong, watertight, permanent joint for excellent wiring protection.

Here's something else: the handy packaging SPANG uses for both its couplings and elbows. They're well-marked, to locate in storage and a snap to inventory. You know, SPANG people say nobody produces a better coupling than do. Know something else? They're right!

This is what one leading electrical contractor says about Spang Conduit Couplings

Thank you, Mr. Millican, for your comments on SPANG Conduit Couplings. Thousands of other electrical contractors share your enthusiasm for this top-quality SPANG electrical product.

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Grounding Outdoor Lighting Standards

Q. *We are planning on illuminating a small public park, using Type RLJFJ lead-covered Parkway cable, direct burial. The metal lighting standards are on concrete bases, and for a large part of the year the soil is very dry.*

In order to follow the NEC (Section 250-42), each standard is to be connected to a common ground conductor, which, in turn, will be grounded to ground rods. I would like to know if the flat-band steel armor in the Parkway cable is satisfactory for use as this grounding conductor.—J.C.K.M.

A. The provisions of Section 250-57, covering the methods of grounding fixed equipment read as follows:

"Metal boxes, cabinets and fittings, or non-current-carrying metal parts of other fixed equipment, if metallically connected to grounded cable armor or metal raceway, are considered to be grounded by such connection. If not so connected, they may be grounded in one of the following ways etc."

Type RLJFJ Parkway Cable is described by General Electric as follows:

"Armored parkway cable (Type RLJFJ) is built to withstand severe mechanical abuse. This type of cable is recommended for the same general types of application as non-metallic cable, but it is built to withstand much more severe mechanical abuse during the installation and operation of the cable. Since the cable is protected by a magnetic armor, the armor bases are from 20% to 40% greater than they are for non-magnetic armored types."

While the heavy steel armor may be in the form of flat metal tapes, it appears to me that it could be used as a grounding conductor for the purpose of grounding the lighting standards under discussion, and fully satisfy the provisions of Section 250-57.

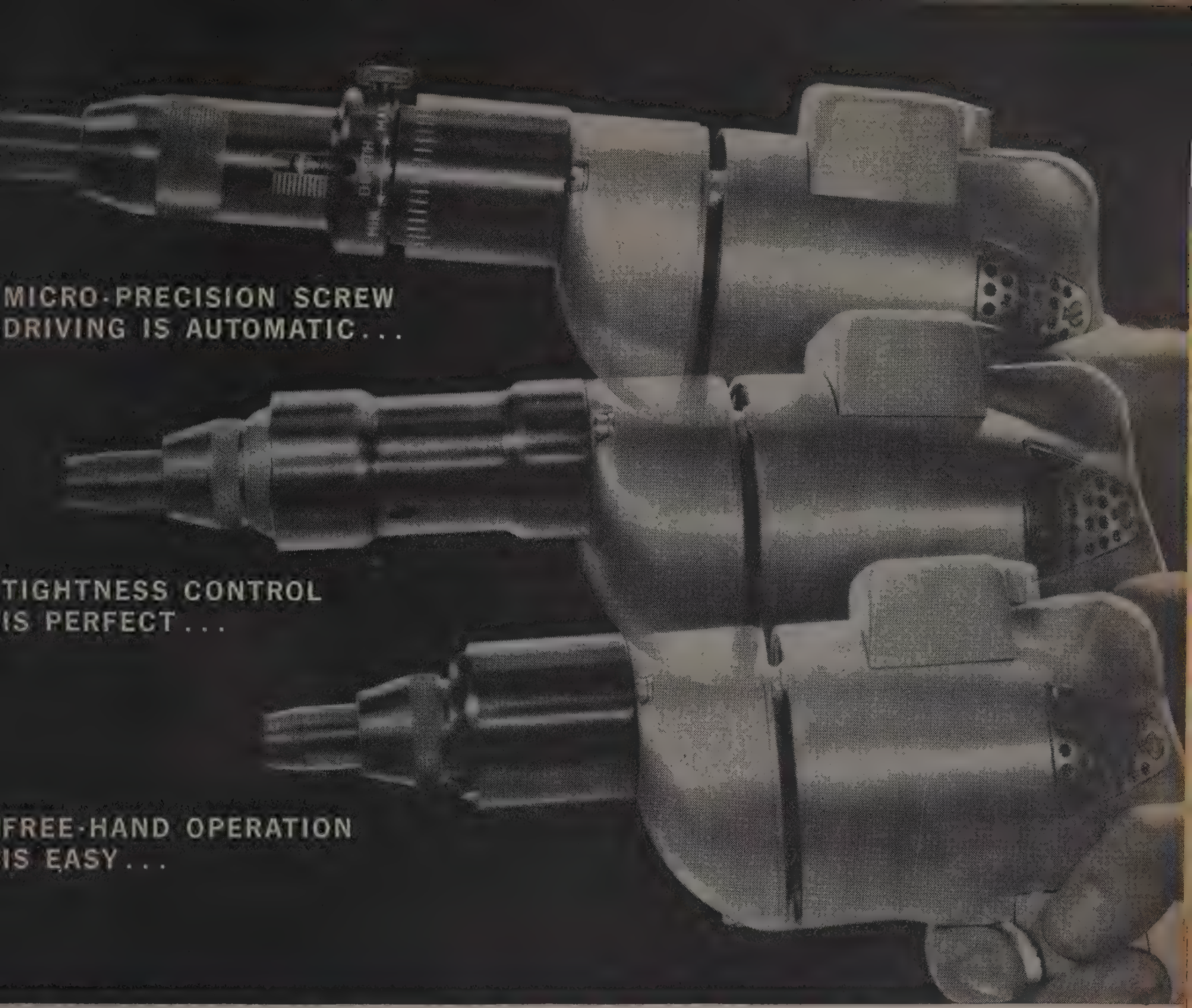
The following advice, received from J. R. Maher, application engineer for the General Electric Co., covers, in detail, the precautions which must be taken when using the armor of a Type RLJFJ cable as a grounding conductor. The use of a lead-sheath as a grounding conductor is recognized under Section 230-62 (b) of the 1959 National Electrical Code.

"Mr. Watson asked me to comment on the question of using the armor of an RLJFJ cable as the means for grounding the metal lighting standards of a public-park lighting system.

"As you may know, a flat-band armor consists of two flat metal tapes (.020 in. thick up to 1 in. diameter cable and .030 in. thick for 1.001 in. and larger), applied helically with the outer tape covering the gap between turns of the inner tape. I think you'll agree that the resistance of such an armor would compare favorably with the resistance of the interlocked armor on armored cables and, of course, the armor of such cable is used for grounding purposes.

"There are, however, a couple of problems involved in making and maintaining a low-resistance connection to this armor. First of all, the jute and the armor of this type of finish is rather thoroughly flushed with an asphaltic compound during manufacture. This means that before a connection is made, the compound will have to be cleaned off with a solvent. Second, the tapes are usually plain rather than galvanized steel, which makes it mandatory that the connection be protected from corrosion by painting and/or taping the joint. In a lighting system, I believe the joints are usually made in the base of the standard, where a removable cover plate is generally provided. In such a case, it is possible to make a steel-to-steel joint (with the steel standard), thus avoiding the possibility of electrolytic corrosion. If it were necessary to make a buried joint to the armor, the corrosion problems would be multiplied, and I would not recommend such a connection. Incidentally, the connection to a flat-band armor would not be made like a connection to armored cable. The tapes should be unwound and the connection made to the ends of the tapes. This is preferable to using a clamp that fits around and squeezes down on the cable, such as a connector.

"I wanted to go into detail above to give you some idea of the problems that come to mind in using the armor as a grounding means; however, I think the solution to the problem presented to you is rather simple since the cable has a lead sheath. The lead would provide a much better means of grounding than the armor. A low-resistance solder joint would be a relatively simple matter and easy to maintain, although it too should be taped. To avoid any potential difference between the lead sheath and the armor during lightning surges, I would recommend that *both* the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lead and the armor be used for grounding.

"In Mr. Watson's letter he mentions 'metal tapes as current-carrying members.' I think I misled him when I told him that the wire armor of a JWJ finish is sometimes used as a current-carrying member. We have never recommended that the armor of a JFJ finish be used to carry current.

"If I can offer further comments on this question I will be happy to do so."—B.A.McD.—10/60/6

Over Nine Conductors in Conduits

Q. *In previous editions of the NEC the running of conductors in conduit was limited to nine. It is noted that the 1959 edition of the NEC will allow more than nine conductors in a raceway.*

Has the above change been made due to actual test having been run, or was the change made only for convenience? What is your opinion concerning the use of over nine conductors in raceways?—A.H.L.

A. The American Iron and Steel Institute has been concerned for several years with the limiting of the number of conductors in a raceway, and this organization sponsored a program of fact-finding and testing to determine whether or not the old limit of nine should be continued as a requirement for such work. The fact-finding investigation and actual test, as conducted by Underwriters' Laboratories, were turned over to the proper NEC panel. The code panel used the results of the investigation and the results of the test, made by UL, in formulating the tables and wording that is now a part of the 1959 NEC. As an electrical inspector, I would certainly go along with this fact-finding investigation and testing in carrying out of my duties as an inspector.—R.E.W.—10/60/7

Type UF Cable Application

Q. *We shall greatly appreciate your opinion of the following questions regarding Article 339 of the NEC. Our City Council has adopted the 1959 NEC without modifications.*

A number of branch circuits in UF cable have been installed underneath a concrete slab (floor) of a building. This concrete slab is poured directly on the ground. The cables are all well below and not in contact with the concrete. The cables come up through the concrete in various partitions through pieces of electrical metallic tubing with an elbow on the bottom below the concrete.

Is this in violation of Article 339?—C.H.C.

A. According to the provisions of Section 339-3-(d), underground feeder and branch circuit cable may be used as follows:

"Type UF cable may be used for interior wiring in wet, dry, or corrosive locations under the recognized wiring methods of this code, and when installed as non-metallic sheathed cable it shall conform with the provisions of Article 336 and shall be of the multiple conductor type."

The definition of a wet location includes underground installations. The provisions of Section 339-3e(6-8) advise that Type UF cable may not be embedded in poured cement, concrete or aggregate.

The provisions of Section 339-3(c) advise that type UF cable buried directly in the earth may need supplementary protection such as a covering board, concrete pad, raceway, etc.

Assuming that the UF cable in question is of the multiple conductor type, a summary of the foregoing code rules indicates that there is no code violation with respect to the installation described in your question.—B.A.McD.—10/60/8

Grounding Meter Sockets-Load Side of Service

Q. *One of our city inspectors insists that a meter socket, when on the load side of a service entrance switch, must have an insulated neutral stud. He bases this on Section 250-61. I have voiced my opinion that he is misinterpreting this section. Please advise if this is the intent of Section 250-61?—L.H.J.*

A. The provisions of Section 250-61 are quoted as follows:

"Grounding Equipment to Circuit Conductor. The grounded service conductor on the supply side of the service disconnecting means

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TYPE BX universal relay shown with 4 poles having both N.O. and N.C. contacts. Additional contacts on the 6 and 8 pole relays are N.O. only.

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NEMA 4

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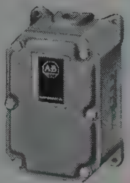
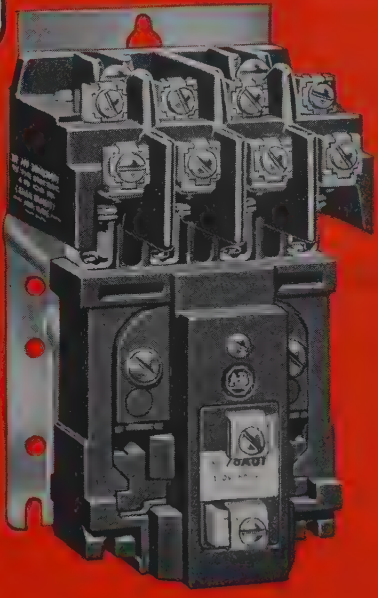


NEMA 7

NEMA Type 7 enclosure for NEC Class 1, Group D hazardous gas locations.

11-60-M



TYPE BR Bulletin 700 convertible contact relay shown with four poles. Made with up to [illegible]

No other relay offers such simplicity in changing contacts from N.O. to N.C. (or vice versa)—it takes only 60 seconds!

A four pole unit provides any of the contact combinations otherwise available only with five relays of the fixed contact type. You can reduce your relay inventories. In tests, this relay has *proved* it will provide many millions of trouble free operations. Double break, silver contacts never need servicing. Also, each relay can have one or two complete and full rated contacts added to its base—in the field—without increasing space requirements. If you don't know about the Type BR relay, let's get acquainted.

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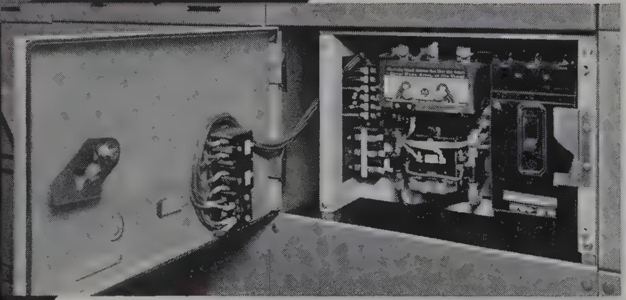
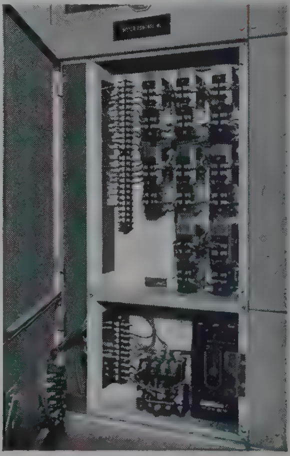


This shows A-B control center unit with popular A-B Bulletin 709 solenoid starter and circuit breaker.

This shows A-B Bulletin 700 control relays mounted in an A-B control center unit.

A-B control centers can be equipped with a wide variety of components. These Bulletin 849 timers are used on an automatic conveyor line.



This huge, 48-foot A-B control center houses 101 A-B Bulletin 709 solenoid motor starters. It is designed to permit an addition containing 50 more Bulletin 709 starters.

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may be used for grounding meter housing and service equipment. The grounded circuit conductor on the load side of the service disconnecting means shall not be used for grounding equipment, cable armor, or metal raceways except as provided in Paragraph 250-57 (b-3), and in Section 250-60".

This rule first appeared in the code as Interim Amendment No. 54, approved June 22, 1942. It clarified the status of meter housings and service equipment with respect to grounding to the grounded service conductor. It appears quite evident that such a method of grounding is not permitted when the meter socket is located on the load side of the service disconnecting means. According to the provisions of Section 250–57(b-3) such a method of grounding could be recognized by "special permission." I believe the intent of this rule is clearly expressed, and the inspector is correct when he requires an insulated neutral stud. It may be difficult to justify the rule on the basis of hazard when the service equipment and the meter housing are immediately adjacent.—B.A.McD.—10/60/9

Mixed Service-Entrance Conductors

Q. *Is it permissible to use a copper conductor with an aluminum conductor in the same raceway? Such as service conductors, e.g., copper neutral, aluminum phase conductors.—R.A.T.*

A. There does not seem to be anything in the code that specifically prohibits this. As far as services are concerned, this is also true with the following possible exceptions for special applications:

Section 230-30, Exception No. 2 would require a bare grounded-neutral conductor, if installed underground, to be copper and to be installed in duct or conduit.

Section 310-10 requires that conductors run in multiple have the same length, the same circular mil area and the same type of insulation. While this section does not specifically so state, it is the intent also, that the conductors should be of similar material, all copper or all aluminum. Otherwise, the resistance (and impedance) would be different and this would cause overloading of some of the conductors.
—B.Z.S.—10/60/10

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The most complete line for splicing plastic and rubber insulated cables

... for splicing polyethylene insulated cable

BI-SEAL Self-Bonding (polyethylene base) Electrical Tape is particularly recommended as the primary insulation for low and high voltage polyethylene insulated wires and cables. Extremely low water absorption . . . low power factor . . . low dielectric constant. Operating temperature to 85°C.

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VINYL Electrical Tape No. 1 & No. 2, .007" and .010" thick, offers complete electrical and mechanical protection for most taping problems . . . Improved method of bonding adhesive prevents transfer, gives greater strength . . . For better looking, more compact splices.

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Gasoline-Resistant Conductors

Q. *Is standard code-grade TW building wire approved for use in conduit, which enters and supplies a gasoline pump on a dispensing island in a regular service station?—H.B.*

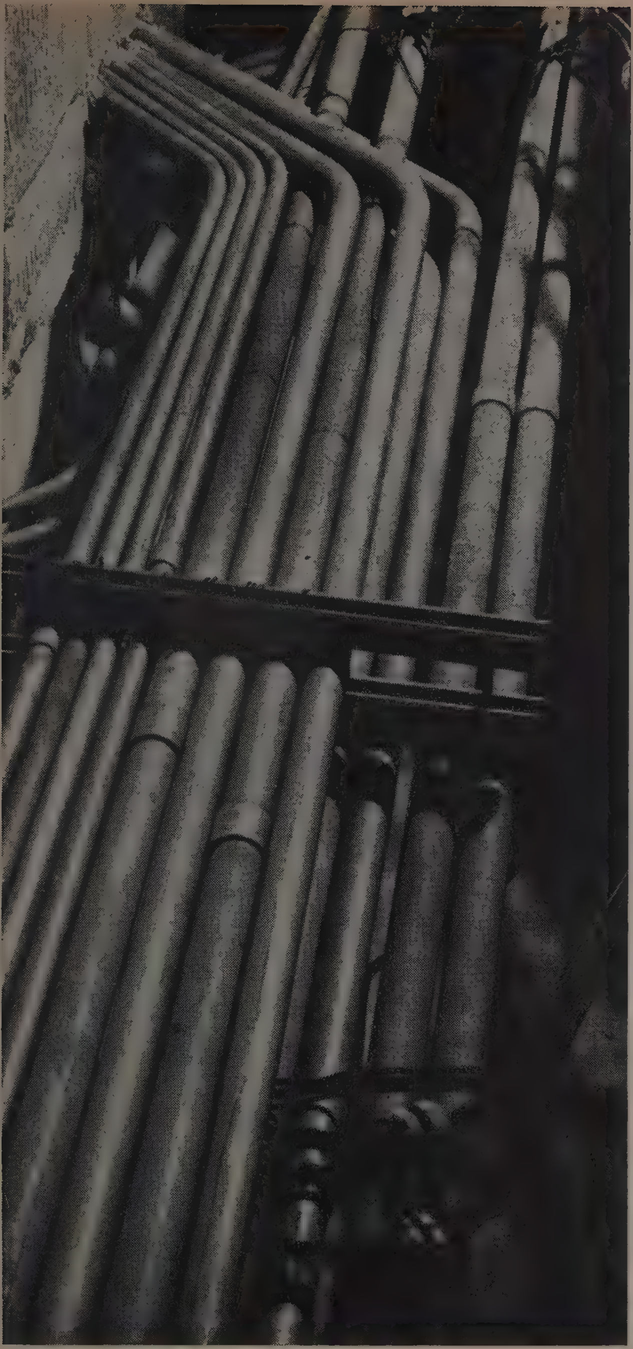
A. No. The fine print note of Section 514-3, 1959 NEC, concerning gasoline-dispensing and service stations, refers to Section 501-13 for special requirements for conductor insulation to be used in hazardous areas such as your question. Section 501-13 states:

"Conductor Insulation Class I, Divisions 1 and 2. Where condensed vapors or liquids may collect on or come in contact with the insulation on conductors, such insulation shall be of a type approved for use under such conditions, or the insulation shall be protected by a sheath of lead or by other approved means."

There is a gasoline-resistant TW conductor and such is identified and marked as stated in the Electrical Construction Materials List of Underwriters' Laboratories:

"Gasoline-Resistant TW—Indicates a TW conductor with a transparent jacket of extruded nylon suitable for use in wet locations, and for exposure to mineral oil, and to liquid gasoline and gasoline vapors at ordinary ambient temperature. It is identified by tag marking and by printing on the insulation under the transparent nylon with the designation "Type TW Gasoline- and Oil-Resistant."

The Southern Section of the International Association of Electrical Inspectors in section meetings on at least two occasions has passed resolutions asking that the National Electrical Code spell out what conductors are approved for such locations in place of the wording which is now used in 501-13 (or by other approved means.) To my knowledge this was requested in 1957 and again in 1958 and is so recorded in the proceedings of the section meetings. It is the writer's opinion that an electrician should have the information available in the National Electrical Code as to what can be approved for use in places such as are outlined in your question in place of having to depend on publications of Underwriters' Laboratories, as UL publications are not widely distributed or used by electricians in various sections of our country.—R.E.W. —10/60/11



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Republic ready-for-the-job *steel* conduit is easy to use, saves installation time, assures trouble-free service . . . because quality is built in.

Made of highest quality, soft, ductile steel, and produced by Republic's famous continuous weld process, Republic Steel Conduit pays off in lower installation costs—with uniformity, ductility, and freedom from hard spots. Clean, free-running threads. Clean inside surface. Tight, hot-dipped galvanized finish will not flake, peel, or chip off.

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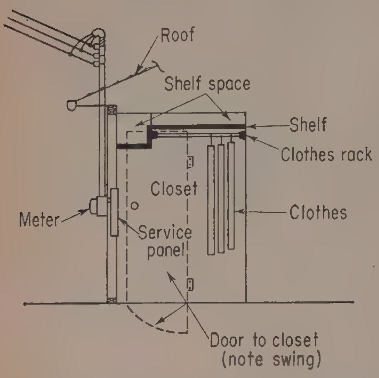
Panels in Clothes Closets

Q. *Can a service panel be installed in a clothes closet in a residence?—K.W.*



A. In Section 240-16 of the 1959 NEC the following statement is made:

"Location in Premises. Overcurrent devices shall be located where they will be:

(a) Readily accessible, except as provided in Section 230-91 for service equipment and Section 364-11 for busways.

(b) Not exposed to physical damage.

(c) Not in the vicinity of easily ignitible material."

In some instances the service panel with overcurrent devices would not be readily accessible in a clothes closet. Therefore, under certain conditions this would prohibit the installation in the clothes closet. I hardly think that (b) of this section would apply; however, (c) would certainly apply unless precaution is taken to guarantee that clothing and easily ignitible material is kept away from such switch or panel such as the drawing indicates. In my opinion it is not good practice to locate service equipment or other panels with overcurrent devices in clothes closets, as it is a well known fact that fires have resulted from such installations. Generally speaking, such locations do not contain enough room for maintenance required, and is not a desirable location for such equipment.—R.E.W. —10/60/12

Grounding Service Equipment Only

Q. *A 3-phase, 3-wire, 240-volt ungrounded service feeds a building with three 1,000 MCM conductors. In this case will a 1-in. conduit or pipe, with no conductor within it, properly ground the service to the building? Reference Table 250-94(b).—L.H.J.*

A. The provisions of Section 250-94(b) are quoted as follows:

"Where the wiring system is not grounded at the premises, the size of a grounding conductor for a service raceway, for the metal sheath or armor of a service cable, and for service equipment shall be not less than is given in Table 250-94(b), except that where connected to made electrodes (as in Section 250-83) the conductor need not be larger than No. 6 copper or its equivalent in carrying capacity."

According to Table 250-94(b), a 3-phase service consisting of 3-1,000 MCM conductors may have its service equipment grounded by the use of 2/0 copper wire, a 1-in. conduit or pipe, or a 2-in. electrical metallic tubing. The use of a copper conductor in conjunction with the conduit, EMT, or pipe is not required. Conduit method of grounding only applies to service raceways, metal sheaths or armor of service cable and equipment.

It is significant to note the distinction between the grounding requirements for systems and service equipment. In the case of a system or common grounding conductor a copper conductor as covered by Table 250-94(a) must be used. Or aluminum of equivalent capacity to copper could be used.—B.A.McD.—10/60/13

Receptacles in Floors

Q. *Under Section* 210-22 (*b*), *the latter part of the first paragraph states "receptacle outlets in floor shall not be counted as part of the required number of receptacle outlets unless located close to the wall."*

How close is close, and what is the usual interpretation of such in modern day homes where we have sliding closet doors, large picture windows and other construction that will not allow the placing of receptacles in the wall space?—D.O.S.

A. Recorded in the 1959 meeting of one of the IAEI section meetings, your question was discussed, and I quote a statement made by one of the code-panel members concerning this question:

"The question has to do with the requirement of some considerable years' standing in the NEC, that outlets in the floor not be counted as one of the outlets required for the regular connection of the equipment, portables, lamps, radios, and what not within the rooms of the dwelling occupancy.

"There has been no change in the wording of the code for a considerable number of years in that respect. The reason for the original requirement was that it was customary in the earlier days of portable appliances, in the late 1910's and the early 1920's, to put into the dining rooms of houses, when they had big dining rooms, a convenient outlet at the dining-room table location, at the hostess end of the table, so that the coffeemaker, the waffle iron, and so forth could be operated from the table in the center of the dining room.

"That outlet, said the code, was not to be counted as one of the outlets required to be mounted in the wall for other purposes. We have carried over into the 1959 Code exactly that same language. When it now becomes apparent that we are going to have to put outlets in the floor to take care of sliding partitions, this word "close" requires some attention. I suspect that nobody would put an outlet halfway between the center of a dining room floor and the wall because it would have no purpose. There would be no occasion other than one close to the wall. Architectural features of the ordinary construction of flooring would probably dictate how close you could get to the wall.

"I am sure if the code put a figure in numbers, somebody would want another ½ in. For practical purposes, I would anticipate no trouble in interpreting this rule. If there are problems about the application of this rule, I think very properly an interpretation would be requested. Until the problem is actually encountered, I would hate to see the code continually cluttered up with finite dimensions where some judgment should be left to the contractor and inspector."

I am in agreement with this statement, and as an electrical inspector I would certainly try to use good judgment in this requirement, and each installation would more or less be treated as an individual job. An inspector could certainly determine whether or not an electrical contractor was sincerely trying to meet the requirements as is outlined in this section—R.E.W. —10/60/14

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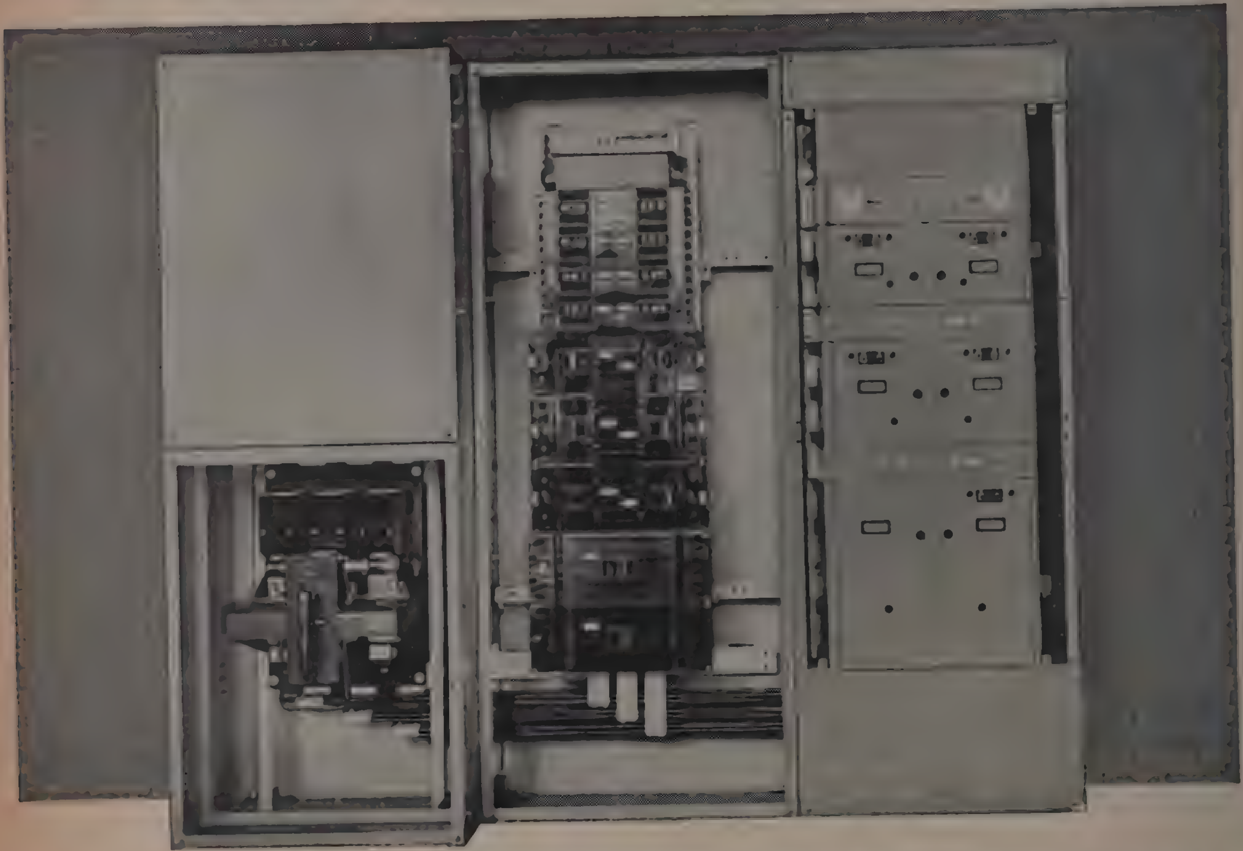

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NALMCO to Develop Service Standards

Development of service standards will be among the major projects of the National Association of Lighting Maintenance Contractors this coming year. Work on a standardized contract form, primarily for national accounts, and formation of an educational program on a national and regional level are also in the offing. This was the energetic program revealed to some 65 members and guests at the annual NALMCO convention held recently in Milwaukee, Wis.

NALMCO is a young (six years), growing (31 new members last year) trade organization dedicated to the development and promotion of sound, economic lighting maintenance practice. Its members offer customers a packaged maintenance program (including cleaning and relamping) designed to keep their lighting systems operating at peak efficiency. Some go even farther and install and maintain a complete lighting system for customers on a lease basis.

That the business of maintaining lighting systems has a tremendous growth potential was evident at the three-day forum-type conference. NALMCO President Mel Galbraith (Cedar Rapids, Ia.) estimates there are from 300 to 500 firms engaged in lighting maintenance throughout the country. But they are maintaining only 15 to 25% of the lighting in the U. S. There is urgent need for organization within the industry, establishment of service standards, and a basic educational program. That is the job NALMCO is set to do, Galbraith asserted.

THE ECONOMICS of using automatic equipment to wash and clean lighting fixtures was presented to NALMCO members at recent convention in Milwaukee by Malger Gray, Fluorescent Service Corp., Tampa, Fla. Gray revealed he recently sold a copy of the machine he designed and built to the Ford Motor Co. in Detroit.

To achieve this goal and to relieve busy members of the organizational burdens, NALMCO has hired an executive secretary. He is Will Carlton of Foster & Davies, Inc., a Cleveland, Ohio, firm retained to handle NALMCO's promotional activities. Based on members' experiences, case histories of planned lighting maintenance programs are now being documented for appearance in appropriate business publications.

National contracts for lighting maintenance are high on NALMCO's promotional list. Before these can be achieved, a standardized service program and service contract must be established, according to Herbert Mendelsohn, Sun Ray Lighting Corp., Kansas City. Mendelsohn reported an encouraging reception among executive personnel of national firms based in New York City. Those interested, however, requested standard programs and contracts that would apply to their branch operations throughout the country. Test programs are now under way in a number of cities, he revealed. Ed Creed, C & S Lighting Maintenance Co., Cleveland, confirmed the need for standards, noting that one company is buying lighting maintenance service for its stores in 17 cities based on a standard specification contract which he developed.

Representatives of General Electric, Westinghouse and Sylvania complemented the formal agenda with discussions on effective sales techniques, the advantages of visual presentations, and how future trends in lighting will affect lighting maintenance contractors. A Smithcraft representative outlined his firm's Lease-Light Plan and noted that it can now include lighting maintenance.

Open-forum discussions predominated the afternoon sessions of the three-day meeting. Split-sessions covered the following subjects: outdoor lighting maintenance; lease lighting; records, forms and systems; equipment cleaning methods; direct mail ideas; use of photography in sales. Session leaders included: William Corbett, Outdoor Lighting Service, Concord, Calif.; John Shaver, Shaver Floodlight Service, Akron, Ohio; Edward Creed, C & S Lighting Maintenance Co., Cleveland; Harry Wolf; Jerome Gimbel, Sun Ray Fluorescent Co., Chicago; Glen Shotola, Lighting Service, Milwaukee; Larry Creech, Lease-Lite Corp., San Francisco; Malger Gray, Fluorescent Service Corp., Tampa, Fla.; Herbert Mendelsohn, Sun Ray Lighting Corp., Kansas City, Mo.; Francis Clark, Lighting Service, Waterbury, Conn.

The meeting closed with a Panel Question Period on the general subject of lighting maintenance.

PRE-SESSION HUDDLE at NALMCO convention in Milwaukee finds contractors (L to R) W. R. Flournoy, Columbus, Ga.; F. E. O'Connor, Sr., Buffalo, N. Y.; and R. E. Watson, Denver, Colo., discussing lighting maintenance programs.

PIONEER MAINTENANCE contractor E. I. Creed (left), C & S Lighting Maintenance Co., Cleveland, compares sales techniques with G. K. Kolbe, New York Maintenance Corp., New York City, at recent NALMCO convention in Milwaukee.

Wall Washer Downlights with Designed Optics by Kliegl

. . . the Great Name in Lighting!

Designed optics . . . controlled wall lighting from an inconspicuous overhead light source. A specially shaped Alzak finished reflector was created for Kliegl Wall Washer Downlights. This unit, with its uniquely shaped reflector, permits the use of a pinhole aperture and produces a soft overall light pattern without annoying hot spots or scallops.

Kliegl Wall Washers are optically designed to correctly illuminate *any* wall whether it is blank or decorated with pictures, murals or tapestries.

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ORIGINATORS AND MANUFACTURERS OF KLIEGLIGHTS

NALMCO'S NEW executive secretary Will Carlton (left), Foster & Davies, Inc., Cleveland, is welcomed into the fold by President Mel Galbraith of Cedar Rapids, Iowa, at recent convention in Milwaukee.

Giving answers to floor questions were the following panel members: Glen Shotola, Milwaukee; Mel Galbraith, Cedar Rapids, Iowa; Robert Watson, Denver, Colo.; Walter Fink, Atlanta, Ga.; Francis Clark, Waterbury, Conn.; Ken Purington, Davenport, Iowa; and Elmo Irwin, St. Louis, Mo.

At the formal business session, conference delegates approved revisions of association by-laws, a code of ethics, an increased dues structure, employment of an executive secretary; and elected the following slate of officers: President—Melvin Galbraith, Approved Lighting Service, Cedar Rapids, Iowa; Secretary—Malger H. Gray, Fluorescent Service Corp., Tampa, Fla.; Treasurer—Ken Purington, Lighting Sales & Service, Davenport, Iowa.

Vice presidents representing the following regional districts include: Central—Van Christenson, Allite Maintenance Co., Toronto, Canada; Eastern—John Razzano, Pittsburgh Fluorescent, Inc., New Castle, Pa.; Mid-Western—R. J. Peters, Addlight Lighting Co., Topeka, Kansas; Western—R. L. Merriam, T. L. Rosenberg Co., Oakland, Calif.; Southern—Walter C. Fink, Senior Fluorescent, Inc., Atlanta, Ga.

Members of NALMCO's Board of Directors include: E. I. Creed, C & S Lighting Maintenance Co., Cleveland, Ohio; Barney Roth, Barney Roth Co., Philadelphia, Pa.; R. E. Watson, Fluorescent Maintenance Co., Denver, Colo.; Eugene St. Jean, St. Jean Lighting Maintenance, West Springfield, Mass.; Elmo Irwin, Lighting Service, St. Louis, Mo.; and Glen Shotola, Lighting Service, Milwaukee, Wis.

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Write for detailed Bulletin 5804-1A. I-T-E Circuit Breaker Co., Dept. TR, 1900 Hamilton Street, Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY

New Industrial Editor Joins Staff

Robert J. Lawrie joins the editorial staff of *Electrical Construction and Maintenance* as assistant editor directly from industry. Mr. Lawrie's diversified, practical electrical background brings additional strength and insight to the publication's editorial coverage of industrial electrification problems.

At the General Electric Company, Utica, N. Y., he was engaged in systems testing of an air-borne computer. At the Kelsey-Hayes Company, New Hartford, N. Y., he was electrical project engineer during construction of their new vacuum induction furnace plant. After completion of the plant, he spent three years as project engineer responsible for electrical control and power engineering, electrical installations, construction, and maintenance.

Mr. Lawrie comes to us after a short period with Remington Rand Univac where he was liaison engineer. He received his electrical training at Mohawk Valley Tech. and at the Utica College division of Syracuse Univ.

IT'S LIKE THIS says Elmo Irwin, Lighting Service, St. Louis, Mo., as Ken Purington, Lighting Sales and Service, Davenport, Iowa, asks a question at recent NALMCO convention in Milwaukee.

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Smart, decorative cluster-lighting of hotels, motels, restaurants, residences with Stonco's crisp "Dart" bullet. Available in 2, 3 or 4 light clusters for wide area illumination.

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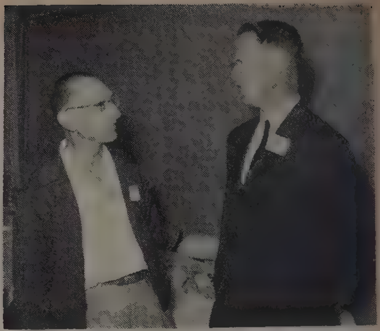


SOUTH AND NORTH meet at NALMCO Milwaukee convention as W. R. Steiner (left), Fluorescent Maintenance Service, Savannah, Ga., confers with Van Christenson, Allite Maintenance Co., Toronto, Canada. Van is central regional vice president of the National Association of Lighting Maintenance Contractors.

NISA News

Fall heralds chapter activity and among the meetings scheduled were these:

- A "heart of the Ozarks" meeting for Heart of America Chapter, at Shadow Rock Hotel, Forsyth, Mo.;
- An all-California meeting of the San Diego, Los Angeles and San Francisco chapters, at the Jack Tar Hotel, San Francisco;
- A joint meeting of Rocky Mountain and Utah chapters, at Albuquerque, N. M.'s Hotel Alvarado;
- The fall meeting of Southwestern Chapter—in Austin, Texas, at the Commodore Perry Hotel;
- A Northeastern (or "North-EASA"?) Conference of the New England, New York, Connecticut, Niagara and Quaker City chapters, at White Haven, Pa., in the Poconos, September 9-11;
- A conference of the three Pacific Northwest chapters (Puget Sound, British Columbia and Oregon), Vancouver, B. C., October 21.

• • • •

NISA's first Jamaica member, R. A. Silvera, Ltd., Kingston, has been enrolled by association president J. Arthur Turner Jr., of Tampa, Fla. The association has members in the U. S., Canada, Mexico, Cuba and Puerto Rico.

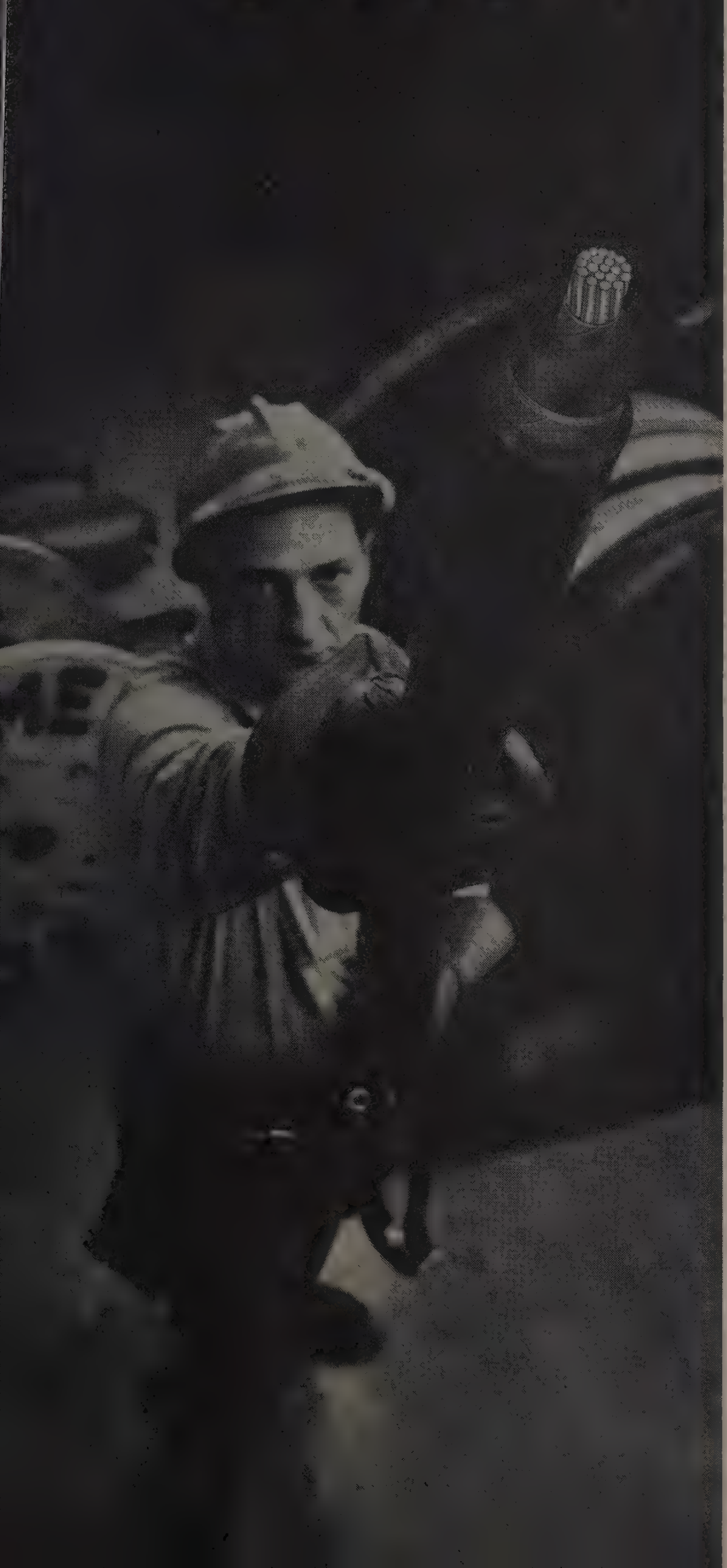
• • • •

William P. Hampton, formerly part owner and manager of the motor shop that had been operated by New State Electric Co., Phoenix, Ariz., has bought the facility and will operate it as State Electric Co.

• • • •

Franklin Electric Co. held a

5 KV? 15 KV?



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Now *you* can go after this profitable business, because Rome has made it possible for you to:

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Popular sizes 5 and 15 kv Rozone Roprene single-conductor cables are currently being stocked at Rome in the sizes most frequently needed.

This gives you a quick answer to a wide variety of cable problems. Rozone is a versatile, long-life insulation that resists ozone and moisture. Roprene is tough neoprene jacketing that resists weather, fire, oils, chemicals, heat and aging.

Start on your next job Your next bid may be on a school, commercial building, or industrial plant which requires high-voltage cable. Be ready for this business. Your Rome distributor is the man to call for 5 and 15 kv cable. Ask him about it this week.

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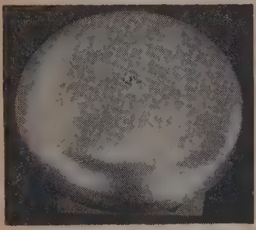
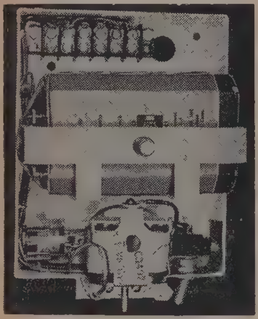


Photo showing 8 in. bell of LIFE SAVER SR. MODEL C1



Inside view showing mechanism of MODEL C1

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We manufacture Underwriters' approved fire alarm thermostats, also home fire alarm panels and bells. Thermostats may be encased in ceiling with only small thermostatic element, which looks like a button, showing below the ceiling.

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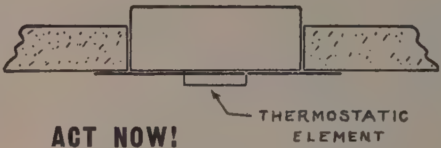

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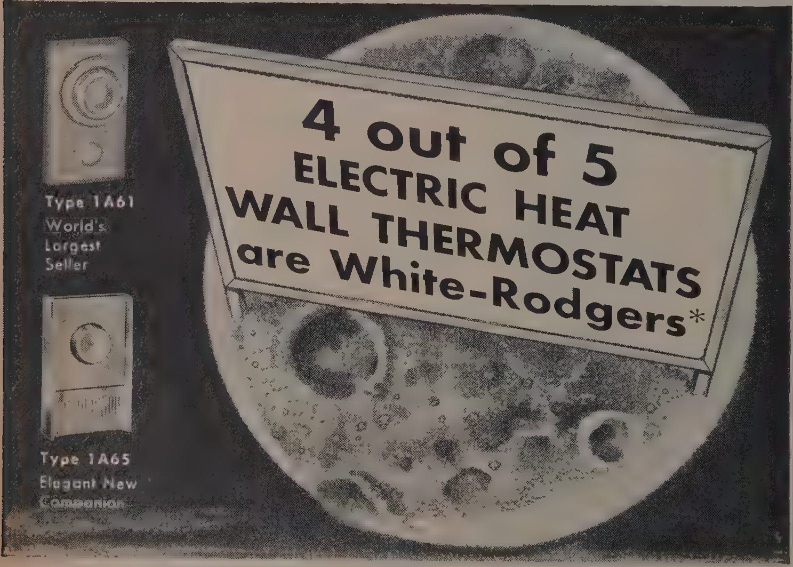

Everywhere . . . people prefer White-Rodgers electric heat wall thermostats—universally famous for styling, easy installation and years of trouble-free performance.

*Sold under the brand names of more than 50 manufacturers.

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LIGHTING MAINTENANCE techniques discussion brings together (L to R) Craig Cunningham; Larry Creech, San Francisco; Wm. Ambrosie and Gordon Woods, Winnipeg, Canada; and John H. Shaver, Jr., Akron, Ohio, in post-session conference at recent NALMCO convention in Milwaukee.

school for submersible pump service shops October 6-7 at its Bluffton, Ind., plant.

• • • •

Several important association events take place during the fall months.

More than 50 presidents and other officers of NISA's forty chapters throughout the United States and Canada will attend the Third Annual Chapter Officers Conference at Clayton Inn, St. Louis, October 14-15.

Thirty electrical apparatus service shop executives will be present for the opening of the 1st NISA Management Seminar October 6-8 at St. Louis University, a three-day program of lectures and discussion on management skills and techniques.

NISA regional directors will convene in St. Louis November 11-12 for their mid-year meeting.

• • • •

The 2nd NISA Practical-Technical Seminar was held in Birmingham, Ala., July 21-23 at Electric Motor Service, Inc., a motor service firm operated by Walter Brush, a regional director of the association and chairman of its Engineers' Advisory Committee. NISA engineer Arthur C. Roe directed the clinic, which was attended by more than 50 shop men from the Deep South.

• • • •

Gene Armstrong, Tom Baker, Dick Bradley, Julian Hupp, Mike Kovall, Don Osenbaugh, Jack Persson, Bob Sandman, Chuck Smith, Dick Wheeler, Al Elson, Paul Sievert, Ed Johnson, Bill Braunlich, Horace Blenkhorn, Charles French and John Overton have been appointed to the NISA Edi-

NEW from General Electric.

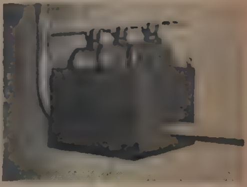
an oil cutout for 15-kv service

A new oil cutout, rated 15-kv, 200 ampere, 95-kv BIL, 7,000 amp I/C, is added to the line of 5.2- and 7.8-kv oil cutouts. This means you can now get a General Electric oil cutout to meet most utility or industrial application needs.

This versatile line of oil cutouts can be dependably used for centralized or single feeder-load break and overcurrent protection in building-vaults, substations, hazardous atmospheres; or where complete submersion is possible. Mount them on poles, or as an integral part of apparatus. However used, General Electric cutouts give you positive load-break and high-current interrupting ability at the lowest cost available.

General Electric oil cutouts are available for either sealed or vented applications. Single units may be individually or gang operated in a rack or metal-enclosed assembly. Cable terminations to meet various requirements can be furnished.

Ask your local General Electric Sales Engineer for more information or write Section 488-04, General Electric Company, Schenectady, New York.



Wall-mounted, metal-enclosed assembly, rated 15 kv, 200 amps.

Stand-mounted metal-enclosed assembly with two—three phase circuits, 15 kv, 200 amps.

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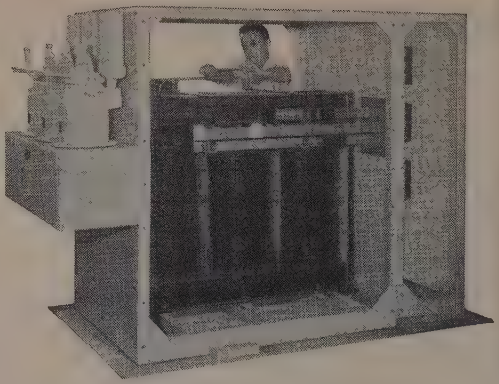

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IMPROVED ACCURACY—
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Of the engineering design time normally required to prepare specifications for special transformer configurations, by far the greatest amount is used in computing the values of standard mathematical formulas. By using a properly programmed digital computer to calculate these values, LAND-AIR is able to greatly reduce the time required, improve the accuracy of the results, select the most efficient of many possible design variations, and take advantage of the most economical manufacturing techniques. For customers requiring transformers of special capacity or having features not found on transformers selected from standard catalogs, insertion of their particular specifications into the pre-programmed computer will produce a DRI-TRAN design having characteristics which meet those individual requirements.

All LAND-AIR DRI-TRAN products meet applicable NEMA and ASA specifications—for further information write or call—

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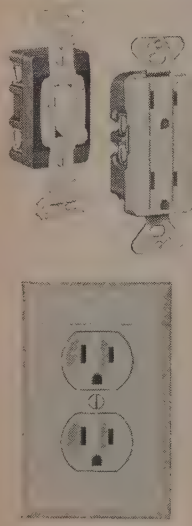

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Its name is
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Switches, Receptacles, Wall Plates—A complete line of wiring devices sold only through Electrical Distributors

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RELAXING after a full session at recent NALMCO convention in Milwaukee, Wisc., are W. C. Abrams, Eveready Electric Co., San Francisco; and Lin W. Best, Best Fluorescent Maintenance Co., Arcadia, California.

torial Board, it has been announced by C. S. Moran, chairman.

• • • •

A new building housing its machine shop was opened recently with ceremonies and an open house by Giles Armature & Electric Works, Marion, Ill.

• • • •

Fred Case has been appointed manager of service and rebuilt equipment sales at the Fred W. Kiemle Co., Toledo, Ohio.

All-day Seminar on Overcurrent Protection

On September 24, 1960, the New Jersey Chapter of the International Association of Electrical Inspectors conducted an all-day seminar on the application of circuit breakers and panelboards in modern overcurrent protection plans. Starting at 9:30 a.m., the seminar ran until 5:00 p.m. and was attended by electrical contractors and engineers from all over the state of New Jersey.

One of the primary objectives of this meeting was to study and discuss the provisions of the 1959 National Electrical Code which requires non-interchangeability in the use of molded-case circuit breakers in lighting and appliance panelboards where conditions of maintenance and supervision are not sufficiently qualified to assure that the breakers will be properly applied. In particular, the code requirement seeks to prevent replacement of a breaker unit with one of higher rating when the conductors of the associated circuit would be left without proper protection. Non-interchangeability must be provided, according to the code, so that there are three non-interchangeable clas-

Announcing an exclusive new development in fibre conduit

A development of Orangeburg and Flintkote Research Laboratories, new *klean-kote* Orangeburg Fibre Conduit has a tough, non-brittle protective coating for cleaner, safer handling. To you and your men, this literally means cleaner hands, cleaner clothes and little or no chance of irritation. In addition, new *klean-kote* travels better, weathers better—and makes a stronger-than-ever joint.

Nothing has been changed in the traditional fine quality of the Orangeburg product. New *klean-kote* is just what the name implies – *a clean coating*. Beneath it lies the same quality product, manufactured with the same painstaking care which has made Orangeburg the best-known, best-selling line in America. Ask your wholesaler to show you a length of new *klean-kote* Orangeburg now.

Cleaner hands

Cleaner clothes

No irritation

klean-kote*

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Fibre Conduit

FLINTKOTE

Orangeburg Manufacturing Co., Orangeburg, New York. Division of The Flintkote Company, Manufacturer of America's Broadest Line of Building Products

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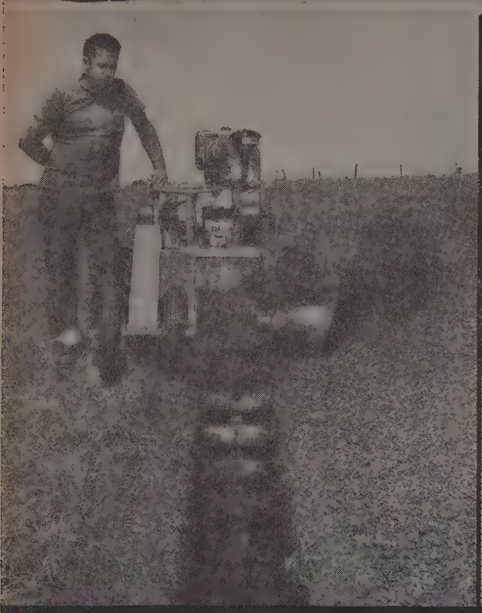
DITCH WITCH TRENCHER

The measure of Success

CALL COLLECT



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SIZE: DIGS FROM 4" TO 16" WIDE AND UP TO 6' DEEP

COSTS: AS LITTLE AS 2c PER FOOT!

ABILITY: JOB PROVEN!

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EASE OF OPERATION: See a demonstration!

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Doors Through 18-inch Walls

How do you cut doors and windows through *18-inch reinforced concrete walls* without ruinous delays? A general contractor got the job done and out of the way with Longyear diamond drilling equipment. *Workmen cut around the openings with 6-inch diamond bits,* and carefully lifted out the giant slabs of concrete. The whole job was done in a few days at low cost and the entire project was kept on schedule. Your Longyear dealer can show you *other* diamond drilling applications that are cutting construction costs, and tell you about the new industrial diamond drills.

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Please send complete information on Longyear Diamond Bits and Industrial Drills. Also the name of my nearest Longyear dealer.

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sifications of circuit breakers rated up to 250 volts and not over 100 amps. These classes are: 0 to 20 amps, 21 to 50 amps, and 51 to 100 amps. The code says that "such circuit breakers or their multiple mounting and bussing means shall be so arranged that it will be difficult, after a circuit breaker has been installed, to replace it with a breaker of a higher ampere classification." And further, "Such circuit breakers of higher than 0 to 20-amp classification shall be difficult to install in the spare spaces which are left for future additions." Although the code says that these provisions are effective as of July 1, 1960, inspection authorities in many places have postponed the date of enforcement on this requirement until January 1, 1961, to give the manufacturers time to develop equipment complying with the new rule. This new date of enforcement coincides with the date given in the code for enforcement of the requirement that all plug fuses must be Type S fuses used with holders or adapters to make the fuses noninterchangeable within two classifications: 0 to 15 amp and 16 to 30 amps. January 1, 1961 is the date of enforcement for non-interchangeability in both CBs and fuses.

At the morning session of the seminar, three guest speakers covered various phases of the NI (noninterchangeable) circuit breaker. Leading off, Howard T. Michener, assistant manager of the NEMA Codes and Standards Committee, spoke for the manufacturing industry and described the various techniques used by the different manufacturers to make their equipment comply with the code rule. He used slides to show the details of the individual breakers and panel mounting constructions, particularly pointing up the use of the special tools which make possible the installation of NI breaker panels. Without these special tools —a special screwdriver or a special wrench, etc.—misapplication of a breaker which would create hazard can be made only with considerable difficulty.

Thorough explanation of the tests used by Underwriters' Laboratories to determine the practicability and suitablility of NI schemes submitted by the various manufacturers was given by Rudolph Fries, associate managing engineer, and Fletcher B. Overman, senior project engineer, both of Underwriters' Laboratories. They reviewed their lab tests on the different schemes

World Headquarters offices of Pepsi-Cola Company, 500 Park Avenue, New York City, are illuminated with ceiling panels of new impact resistant rigid vinyl sheet panels of modular design. Illumination level is 50 foot-candles at desk height. The BAKELITE vinyl panels were fabricated by Piolite Plastics Corp. Lighting was by Globe Lighting Products, Inc., and installation by Fischbach and Moore, Incorporated.

Refreshing light for the "light refreshment"...

LUMINOUS CEILINGS OF HIGH-IMPACT VINYL PANELS LIGHT NEW PEPSI-COLA WORLD HEADQUARTERS BUILDING

IN MANY towering offices along New York's famous Park Avenue, translucent ceilings made of BAKELITE rigid vinyl sheet improve lighting efficiency and enhance decor. Here, in the World Headquarters of Pepsi-Cola, panels of new *high-impact* BAKELITE rigid vinyl sheet form a glowing, handsome ceiling. No shadows at eye level . . . no problem of balancing daylight and interior lighting. This is custom-made illumination—so natural, you are hardly aware of its existence!

BAKELITE rigid vinyl sheet forms panels with extra resistance to hard knocks and rough handling during installation and maintenance . . . they are resistant to warping and cracking . . . they go years without discoloration by ultraviolet. Costs can be cut because much thinner sheets can be used than for other types of diffusers. They're self-extinguishing, and in addition the installation can be designed so they'll soften and fall out before the sprinkler operating temperature.

With new BAKELITE high-impact vinyl sheet you get greater freedom of design . . . new beauty for older fixtures . . . much longer service life.

Write today for more information! Dept. DT-41, Union Carbide Plastics Company, Division of Union Carbide Corporation, 270 Park Ave., New York 17, N.Y.

UNION CARBIDE

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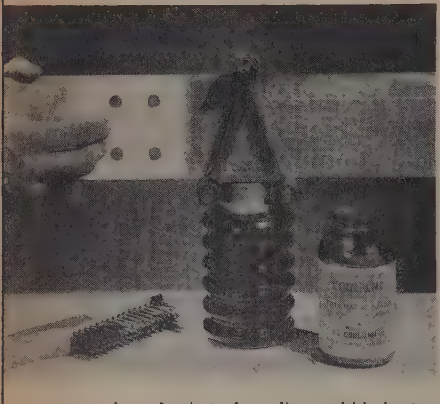
SILVER PLATING

"ON THE JOB" WITH POWDER



Cool-Amp Silver Plating Powder deposits a genuine coat of silver that will not peel off, and will provide lasting protection against oxidation. It has been used extensively and is accepted as equal to electroplating for bolted and stationary contacts.

REDUCES MAINTENANCE—
SAVES ELECTRICITY

Cool-Amp minimizes overheating and provides cool maximum conductivity for your copper, brass or bronze contacts. Used on all current carrying connections. Cool-Amp silver plating assures long life and low maintenance and will prevent series of losses from oxidation that are too small to create noticeable heat but still accumulate into major power loss. Apply to fuse clips and blades to reduce overheating.

Cool-Amp contains no cyanide and is simple to apply. It can be used by any number of people at the same time ON THE JOB in underground vaults, sub-stations and hard-to-get-at places. The only equipment needed is a sharp steel wire brush or abrasive cloth, clean rag, water. One pound will plate approximately 6,000 sq. in.

$13.50 PER POUND—SHIPPED PREPAID
WRITE FOR FREE SAMPLE AND QUANTITY QUOTATIONS

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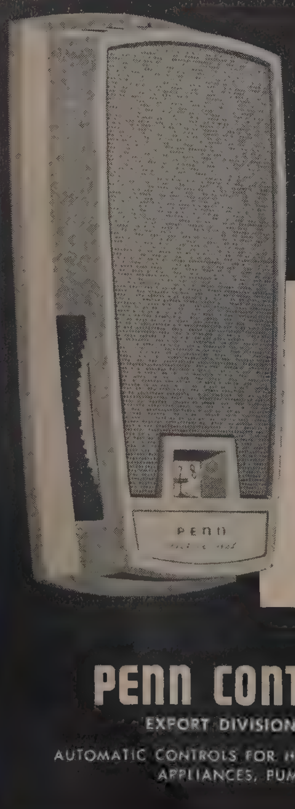

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NEW IDEA

in electric heat thermostats

There's no other room thermostat like it. Its large dial actually "meters" desired temperature changes. Each "click" is a change of 1° . . . reduces tendency to over-, or under-adjust. And, it gives faster response to both convective and radiant heat. You'll also like the faster installation and easier wiring. Write for Bulletin 3205 . . . it's free!

PENN CONTROLS, INC. Goshen, Indiana

EXPORT DIVISION: 27 E. 38th ST., NEW YORK, N. Y.

AUTOMATIC CONTROLS FOR HEATING, REFRIGERATION, AIR CONDITIONING, APPLIANCES, PUMPS, AIR COMPRESSORS, ENGINES

and demonstrated their procedures for evaluating various equipments. They showed dozens of color slides of CB construction details and panel bussing arrangements to clarify the intent and scope of the rule as they interpreted it and to familiarize the audience with the approved types of NI construction.

The afternoon session began with a panel discussion of questions from the floor. The panel consisted of the guest speakers of the day and representatives of the various manufacturers of circuit breaker equipment. Highlights from this lively discussion include the following:

Q. Will old type panelboards, ones in which breakers can be readily interchanged, be permitted in installations after January 1, 1961?

A. Yes, when installed where maintenance and supervision are qualified to assure against improper changing of breakers. It should be noted carefully that the new code rule applies only to panelboards in residential and other occupancies where qualified maintenance is not available.

Q. Will the special tool required for any NI system be supplied free by the manufacturer?

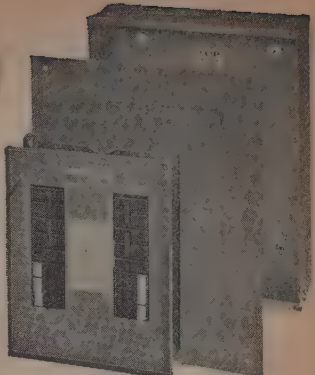
A. Some will supply it free; others will not. But such tools will be available only through regular distributors to prevent their falling into the hands of do-it-yourself mechanics.

Q. Will there be any unit breaker interchangeability between NI panelboards and old type panelboards?

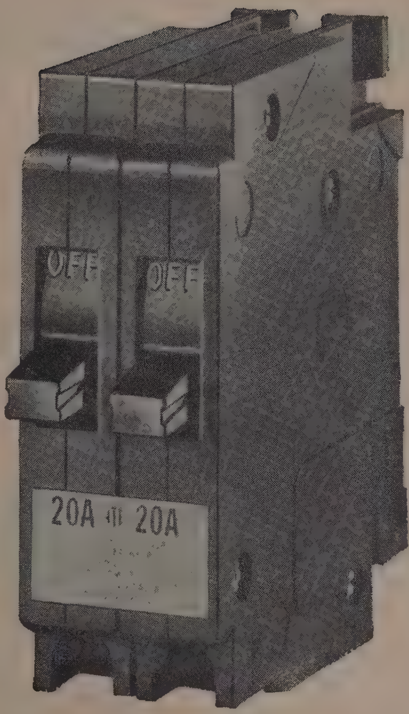
A. No. The new type NI panelboard will be listed by the UL for use with the breaker units designed for it. Such panels will be labelled as to the exact type of CB they can properly accommodate. Any other type of CB—whether of the same or a different manufacturer—must not be used in the panel even though it may physically fit. The UL listing applies only to the originally approved conditions of application.

To meet a growing demand among electrical contractors and engineers for more application data on overcurrent protection in heavy capacity feeders — industrial and commercial secondary feeders, large service entrance and heavy motor circuits—the program included a talk on Overload and Short-Circuit Protection for Heavy Capacity Applications, by J. F. McPartland, associate editor, *Electrical Construction and Maintenance.* This talk covered the characteristics of modern overcurrent protection, including time-delay overload protection, short-circuit protection, and effec-

I-T-E
Uni-Pak
PANELS



FLEXIBILITY ...AND NOW... MORE CIRCUITS in HALF the SPACE WITH EQ·T



Uni-Pak loadcenters have long offered maximum flexibility, superior construction and exceptional features . . . qualities that have distinguished the I-T-E line.

Now . . . the EQ-T DUAL is available to make the Uni-Pak loadcenter even more flexible than ever. It's a compact, dual-breaker . . . two circuit breakers in a 1″ case. The EQ-T DUAL is quick-make, quick-break, trip-free, with low range instantaneous thermal-magnetic tripping—miniaturized without sacrificing any of the well-known I-T-E quality.

I-T-E plug-in circuit breakers plus the I-T-E Uni-Pak provide the best and most flexible loadcenter line available today.

For additional information, write I-T-E Circuit Breaker Company, Walker Division, 125 Bennett Street, N. W., Atlanta 9, Georgia. Ask for Bulletin NI-100.

I-T-E

I-T-E CIRCUIT BREAKER COMPANY
WALKER DIVISION

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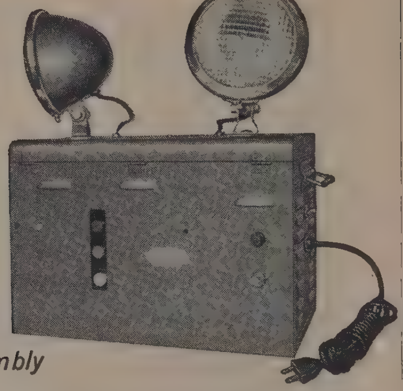
AUTOMATIC EMERGENCY LIGHTS



for commercial buildings, retail stores, institutions factories . . . and other places of public assembly

No building is completely safe without protection from the hazards of sudden blackouts. Leading industries have adopted BIG BEAM for their emergency lighting needs. When regular lights fail, BIG BEAM goes on instantly and automatically. Provides hours of bright, safe illumination, until power from circuit is restored. BEAM-O-MATIC recharges itself automatically.

BEAM-O-MATIC shown above is one of a variety of BIG BEAM models available. Whichever BIG BEAM you select, you are providing the utmost in dependability.

For complete information, write today to 9475

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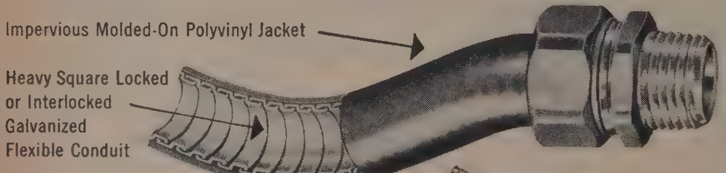
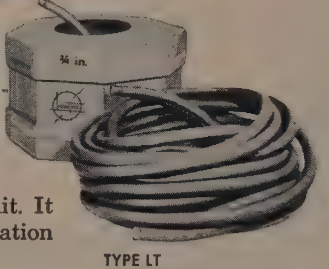
FLEXIBLE LIQUID-TIGHT WIRING CONDUIT


Impervious Molded-On Polyvinyl Jacket
Heavy Square Locked or Interlocked Galvanized Flexible Conduit



. . . nor can grease, dirt, oils, alcohols or most other corrosive vapors, acids, or other harmful elements. Circuits are *completely* protected.

Liquatite can be installed as quickly and easily as Flexible Conduit, yet assures the protection of Rigid Conduit. It follows contours, absorbs motion, vibration and shock indefinitely.

TYPE LT J.I.C. APPROVED

TYPE LA UNDERWRITERS APPROVED

Find out why Liquatite is serving industry everywhere. Write today for free sample, costs and name of Distributor nearest you.

ELECTRI-FLEX COMPANY

P.O. BOX 128C • ROSELLE, ILLINOIS

tive coordination schemes for series devices in a system. Short-circuit analysis was presented, and the varying characteristics of standard and current-limiting fuses and molded-case and power circuit breakers were correlated to specific tasks in achieving selective operation for minimum loss of power and in reducing the thermal and magnetic stresses of let-through fault energy.

Several special exhibits are planned by industry groups. The National Electrical Contractors Association is planning a display for their October exhibition in Las Vegas, Nev.

National Electrical Week Plans

Plans to make the 1961 observance of National Electrical Week another outstanding industry endeavor were formulated in New York recently at a meeting of the fall NEW Committee, representing all the major segments of the electrical industry. The 1961 Week will be observed February 5-11.

The 1961 Planning Guide is in production and will be distributed to 6,000 industry leaders and groups throughout the country in mid-October. It will outline details of how various participating groups can plan and carry out their own NEW observances.

Chairman Harold A. Webester announced that more than 80 companies have been contacted in efforts to build a strong nationwide backdrop for the Week's activities. The 80 firms engage in extensive national advertising in television, radio, newspapers, trade and shelter magazines and other media.

The Week's nine sponsoring groups have announced plans to do extensive communications jobs within their memberships to spearhead the observance. The sponsoring organizations are: American Home Lighting Institute, Canadian Electrical Council, Edison Electric Institute, International Association of Electrical Leagues, International Brotherhood of Electrical Workers, National Appliance Service Assn., National Assn. of Electrical Distributors, National Electrical Contractors Assn. and National Electrical Manufacturers Assn.

In addition, a number of observance materials will be offered through the NEW headquarters—speeches, reproduction proofs of NEW emblem, special pamphlets and display materials, etc.

How to determine proper Control Run for Remote Control Switches

With remote control switches (as with any electromagnetically operated device), it is absolutely essential that maximum allowable run for each switch should not be exceeded.

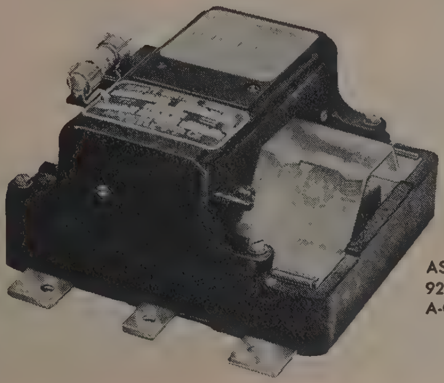
Here is a handy guide to help you determine admissible distances between switch and remotely located control station:

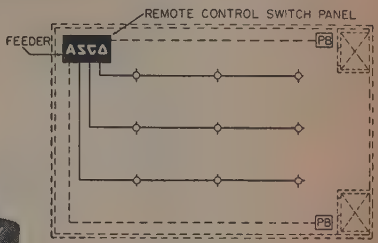
1. Doubling the control voltage will increase the allowable run with the same size of wire by about 4 times.
2. Doubling the cross sectional area of the control conductors will increase the allowable control run by 2 times. The cross sectional area of a conductor will approximately double with three gauge number sizes larger wire. Thus #14 has approximately double the area of #17, and one-half the resistance per unit length.
3. Full consideration should be given to the use of auxiliary relay control for remote control switches, particularly for group installations requiring master control and for extremely long runs.

The following tabular data specify maximum distance between control station and one Bulletin 920 switch with source line voltage at 90% of normal. Similar charts are available on the range of ASCO "remotes."

AMPERES	B&S GAUGE	DISTANCE IN FEET 110 V. 60 CYS.	220 V. 60 CYS.*
30,60,75	14	550	1600
	12	900	2600
	10	1400	4200
100,150,200	14	325	1200
	12	500	1900
	10	800	3000

*For 208 volt system, reduce 220 volt values by 30%.





PB= REMOTE CONTROL POINTS

ASCO 3-pole, remote control switch, Bulletin 920, is UL approved to 200 amps A-C, 600 v A-C, 250 v D-C.

Why Mechanically Held

A remote control switch is essentially a feeder disconnect switch. Consequently, it is usually installed in a lighting or power distribution panel feeding numerous circuits. In function the disconnect switch used should operate just like the manually operated type of disconnect switch—it should be unaffected by line voltage conditions and should respond only to the control of the push buttons.

Only a mechanically held switch can meet these requirements. Magnetically held contactors, which open on momentary line voltage dips and control circuit derangements, introduce the hazard of complete outage on vital circuits until repairs can be made.

ASCO Mechanically Held Remote Control Switches are unaffected by line voltage conditions; each switch includes a manual operating knob or handle so that the switches can be operated manually at any time.

The values for control run listed are for one switch. For installations involving more than one remote control switch connected to the same control conductors, the values listed can be considered as switch-feet. The allowable run for group installations will be equal to the listed values divided by the number of remote control switches operating from the same control conductors. Thus, if one switch has an allowable run of 100 feet with #14 wire, ten switches will be limited to 10 feet. When switches are located along a transmission control line, calculations in terms of switch-feet will produce the solution.

Dependable control by ASCO

New catalog 57-S2 on ASCO Remote Control Switches is now available. Write today for this basic reference on dependable electromagnetic control.

ASCO Electromagnetic Control

Automatic Switch Co. 50-J HANOVER RD., FLORHAM PARK, N. J., FRONTIER 7-4600

AUTOMATIC TRANSFER SWITCHES • SOLENOID VALVES • ELECTROMAGNETIC CONTROL

ASCO

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Ask for Bulletin 160.

Enlarged Edition

Adalet

CAST-ALUMINUM WEATHER-PROOF and EXPLOSION-PROOF HOUSINGS

THE Adalet MANUFACTURING COMPANY
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Bulletin 160

THE Adalet MANUFACTURING COMPANY
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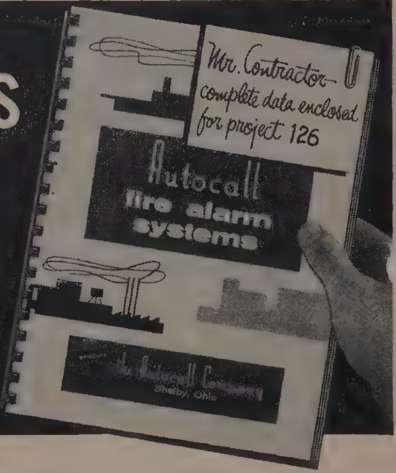
YOU CUT COSTS of installation 3 WAYS with Autocall


Mr. Contractor— complete data enclosed for project 126

Autocall fire alarm systems

The Autocall Company
Shelby, Ohio

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New Books

A Short Dictionary of Mathematics, by C. H. McDowell. 63 pages; $2.75. Philosophical Library, 15 E. 40th Street, New York 18, N. Y.

Useful to anyone handling figures, this book defines in simple language all mathematical terms in common use in arithmetic, algebra, geometry and trigonometry, with many explanatory drawings.

Mathematical Tables and Formulae, by F. J. Camm. Sixth Edition. 144 pages; $2.75. Philosophical Library, 15 E. 40th Street, New York 18, N. Y.

A handy compilation of most frequently needed arithmetical, trigonometric and algebraic tables and formulae. Typical of those included are standard mathematical symbols, weights and measures, and conversion tables.

Differential Equations for Engineers, by Philip Franklin. 299 pages; $1.65. Dover Publications, Inc., 180 Varick St., New York 14, N. Y.

Designed to make differential equations readily accessible to the engineer and physicist, this book deals with theory as well as application. Included are more than 400 problems on electricity, heat, and other areas.

Mathematics Refresher, by Kurt Wolter. 96 pages; $2.75; Philosophical Library, 15 E. 40th Street, New York 18, N. Y.

A review of mathematics at the algebra level, including fractions and proportions, equations of the

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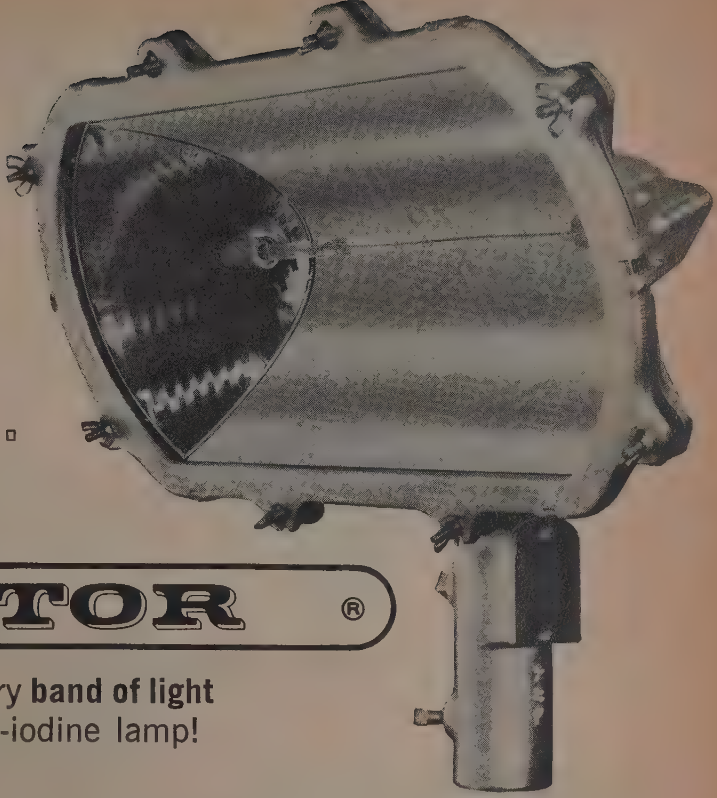

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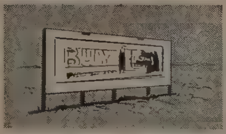
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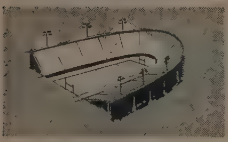
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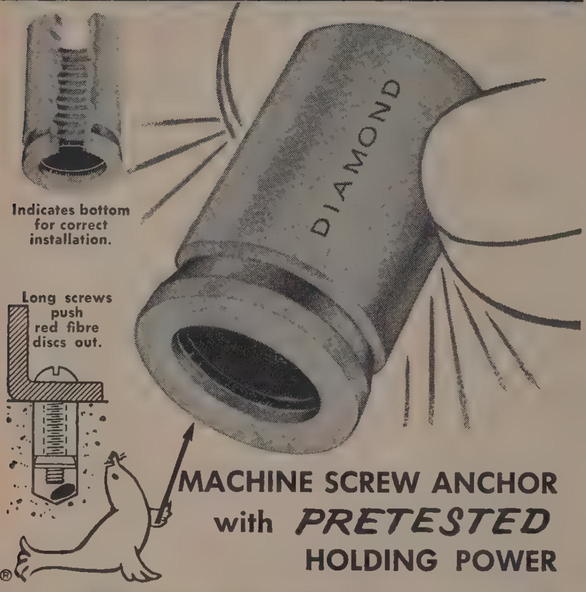
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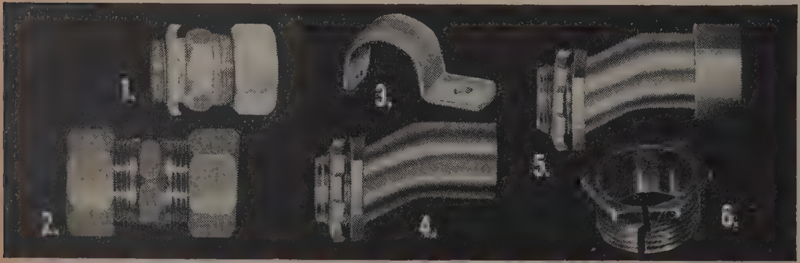

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Fundamentals of Mathematics, by E. P. Vance. 469 pages; $7.50. Addison-Wesley Publishing Co., Inc., Reading, Mass.

A text presenting a unified treatment of the basics of algebra, trigonometry, and analytic geometry, plus an introduction to calculus. Adequate coverage for study of advanced mathematics.

Tensors for Circuits, by Gabriel Kron. Second edition. 250 pages; $1.85. Dover Publications, Inc., 180 Varick St., New York 14, N. Y.

A new method of approaching electrical engineering problems, through tensor analysis, presenting applications to polyphase machines and other rotating machinery, regulating devices, speed control systems, and transformers.

Calculus Refresher for Technical Men, by A. A. Klaf. 431 pages; $2.00. Dover Publications Inc., 180 Varick St., New York 14, N. Y.

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Calculus and Analytic Geometry, by George B. Thomas, Jr. Third edition. 1010 pages; $9.75. Addison-Wesley Publishing Co., Inc., Reading, Mass.

A complete text for science and engineering personnel. All important equations are boxed to highlight their importance. Includes review of trigonometry.

Practical Electroacoustics, by Michael Rettinger; 271 pages, $10.00. Chemical Publishing Co. Inc., 212 Fifth Avenue, New York, N. Y.

A description and analysis of the essential units of audio equipment, including microphones, loudspeakers, magnetic recording devices, and related equipment. Engineering information presented uses mathematics where required to present the laws, facts and applications necessary for a complete study of the subject.

Electroplating, by J. B. Mohler and H. J. Sedusky; 257 pages, $5.00. Chemical Publishing Co., Inc., 212 Fifth Avenue, New York, N. Y.

Written for the engineer, metallurgist, or chemist who has little or no knowledge of electrodeposition and plating. Mechanics, laws, and characteristics are discussed, followed by detailed treatment of baths and plating processes in use.

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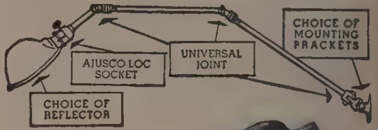

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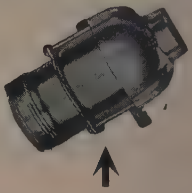

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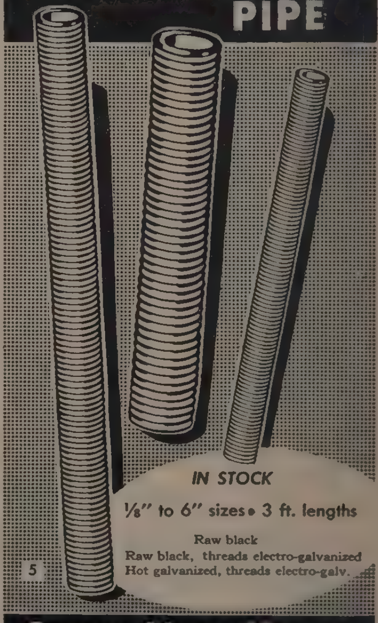

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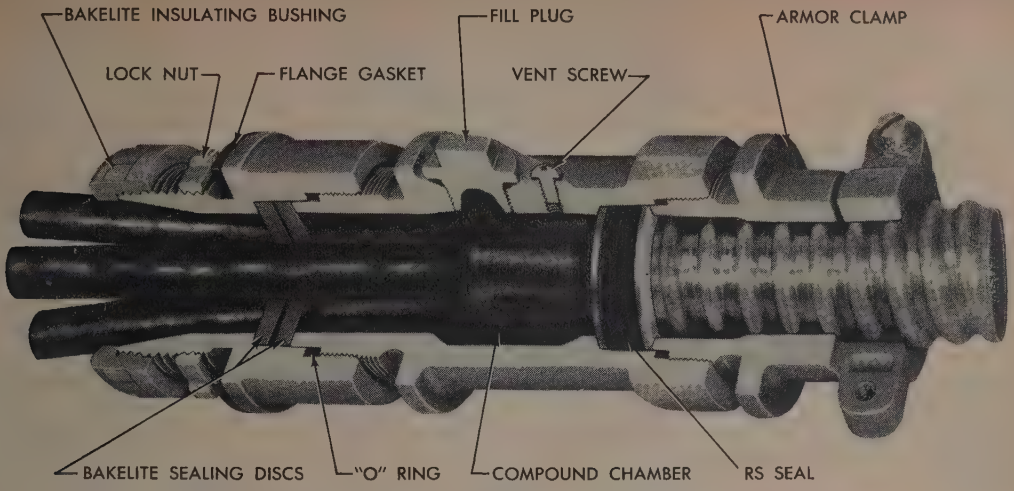

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Engineers' Illustrated Thesaurus, by Herbert Herkimer; 572 pages; $6.00. Chemical Publishing Co., Inc., 212 Fifth Avenue, New York, N. Y.

A virtual combination illustrated dictionary and idea book for the designer and engineer, presenting diagrams and drawings of such categories of technical devices as fasteners, supports and structures, basic mechanical movements, prime movers, electrical equipment, comfort heating, cooling, and air conditioning.

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Basic instruction on reading and setting side rule scales to perform all arithmetical and trigonometrical functions.

Elementary Engineering Mechanics, by Eugene George Key; 457 pages. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y.

Designed for two-year technician programs, this book covers both statistics and dynamics, requiring a basic background in algebra and plane geometry.

Concise Dictionary of Science, by Frank Gaynor; 546 pages; $10.00. Philosophical Library, Inc., 15 East 49th St., New York 16, N. Y.

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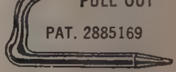

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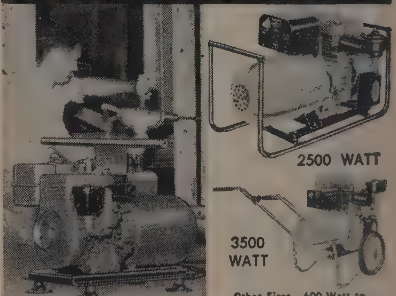

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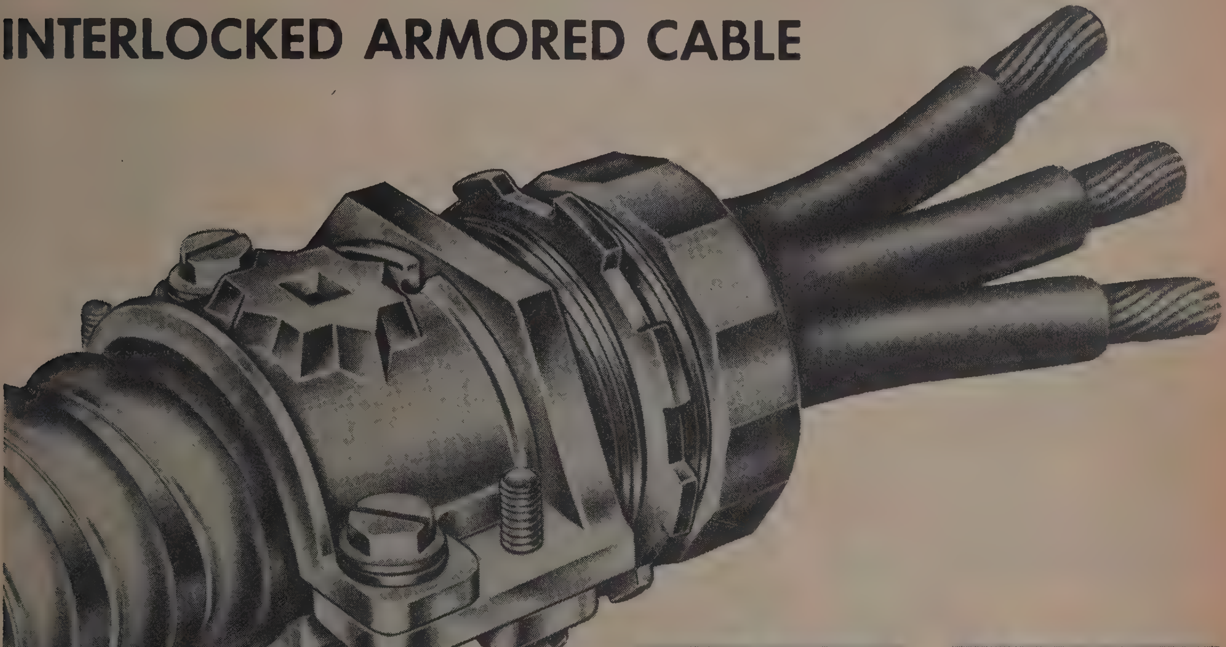

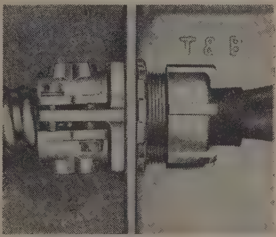

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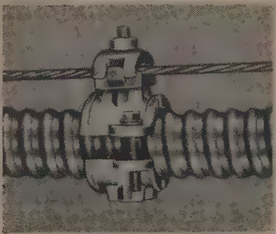

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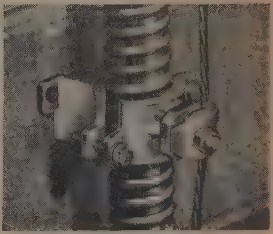

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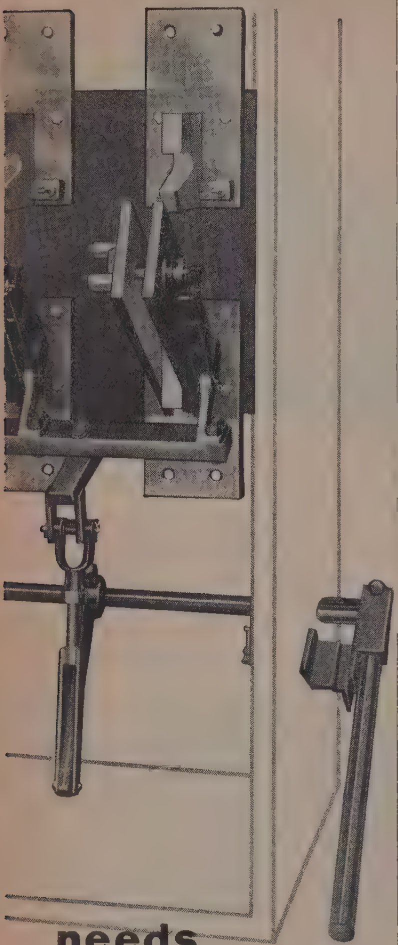

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International Association of Electrical Inspectors—Southern Section, Rice Hotel, Houston, Texas, October 17-19; **Canadian Section,** Toronto, Ont., Canada, October 28-29.

NISA Chapter Meetings—King Coal, Evansville, Ind., October 13, and Mount Vernon, Ill., January 12, 1961; **British Columbia, Oregon and Puget Sound,** Grosvenor Hotel, Vancouver, B. C., October 21.

Florida Association of Electrical Contractors — Annual Convention and 8th Electrical Trade Show, Deauville Hotel, Miami Beach, Fla., October 12-15.

48th National Safety Congress—Annual convention of the National Safety Council, Conrad Hilton Hotel, Chicago, Ill., October 17-21.

Electrical Exposition — Sponsored by the MUIDA Division of the Central Jersey Electrical League, 112th Field Artillery Armory, Trenton, N. J., October 18-20.

National Electrical Contractors Association—1960 annual convention, Las Vegas Convention Center, Las Vegas, Nev., October 23-27.

National Fire Protection Association—Fall Conference, Columbus, Ohio, November 14-16.

National Electrical Manufacturers Assn.—Annual meeting, Traymore Hotel, Atlantic City, N. J., November 14-18.

Electrical & Home Appliance Show—Electrical Building, Balboa Park, San Diego, Calif., November 25-30.

The Third National Conference on the Application of Electrical Insulation—Co-sponsored by the AIEE and NEMA, Conrad Hilton Hotel, Chicago, Ill., December 5-8.

Industrial Heating Equipment Association, Inc.—Dearborn Inn, Dearborn, Mich., January 23-24, 1961.

Plant Maintenance and Engineering Show—International Amphitheatre, Chicago, Ill., January 23-26.

Intermountain Electrical Association—Annual conference, Hotel Ben Lomond, Ogden, Utah, February 2.

Power & Communications Contractors Association—Annual convention, Sir Francis Drake Hotel, San Francisco, Calif., February 5-7.

National Electrical Week — National promotion, February 5-12.

National Rural Electric Cooperative Association—19th annual meeting, Dallas, Texas, February 13-16.

15th International Heating & Air-Conditioning Exposition—International Amphitheatre, Chicago, Ill., February 13-16.

3rd Biennial Electrical Trade Conference and Exposition—Sheraton-Park Hotel, Washington, D. C., February 14-16.

Upper Midwest Electrical Industry Convention — Leamington Hotel, Minneapolis, Minn., February 19-22.

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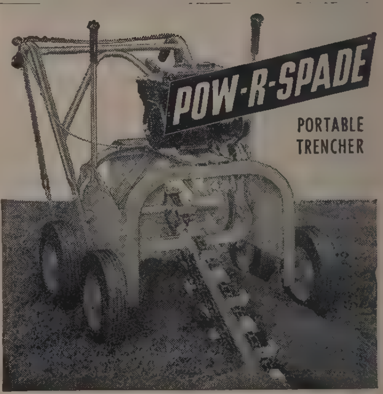

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STAMPINGS INC., Dept. E, Rock Island, Ill.

National Electric Sign Association—Convention, Benjamin Franklin Hotel, Philadelphia, Pa., Feb. 19-22.

17th Annual National Wiring Sales Conference—Sherman Hotel, Chicago, Ill., February 23-24.

3rd National Lighting Exposition and World Light Forum—Coliseum, New York City, N. Y., March 8-15.

Edison Electric Institute — Annual sales conference, Edgewater Beach Hotel, Chicago, Ill., March 20-22.

Institute of Radio Engineers, Inc.—International Convention and Show, Waldorf-Astoria Hotel and New York Coliseum, New York City, March 20-23.

American Power Conference—Sherman Hotel, Chicago, Ill., March 21-23.

Nebraska Iowa Electrical Council—4th Biennial Nebraska Iowa Electric Trade Show, Peony Park Auditorium, Omaha, Neb., March 21-23.

Electrical Supply Trade Show—Sponsored by the Electrical Association of Kansas City, Exhibition Hall, Municipal Auditorium, Kansas City, Mo., March 28-30.

Electrical Trade Show—Sponsored by St. Louis Electrical Board of Trade, April 4-6.

Northern California Electrical Industry Show—Sponsored by the Electrical Maintenance Engineers' Association of Northern California, Brooks Hall, San Francisco, Calif., April 5-9.

Missouri Valley Electrical Association—Annual engineering conference, Hotel President and Municipal Auditorium, Kansas City, Mo., April 12-14.

2nd Annual Alabama Electrical & Electronics Exposition—Birmingham Municipal Auditorium, Birmingham, Ala., April 17-19.

National Association of Electrical Distributors—53rd annual convention, Detroit, Mich., April 29-May 3.

National Fire Protection Association—Annual convention, Hotel Statler, Detroit, Mich., May 15-19.

Pacific Coast Electrical Association, Inc.—Annual convention, Sheraton-Palace Hotel, San Francisco, Calif., May 17-19.

Edison Electric Institute—Annual convention, New York City, June 5-7.

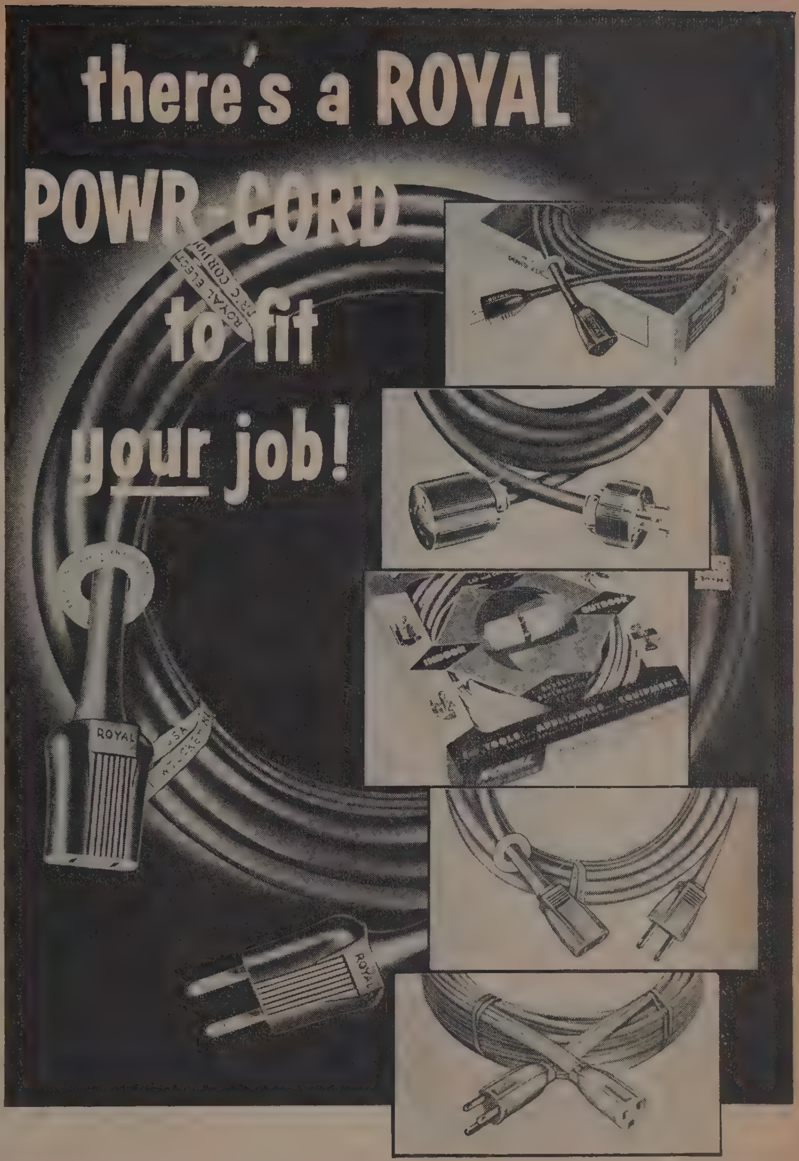
Electrical Apparatus Service Association, Inc.—28th annual convention, Jack Tar Hotel, San Francisco, Calif., June 11-14.

Western Plant Maintenance Show—Pan American Auditorium, Los Angeles, Calif., July 18-20.

Western Electronic Show and Convention—Cow Palace, San Francisco, Calif., August 22-25.

American Home Lighting Fixture Month—Sponsored by the American Home Lighting Institute, Chicago, Ill., September 1-30.

Canadian Electrical Manufacturing Association—Annual meeting, Sheraton Brock Hotel, Niagara Falls, Ontario, October 4-6.



The *right* extension cord is essential for safe, dependable operation of on-the-job equipment and temporary lighting . . . the *right* size to carry the load, the *right* length to supply the power without voltage drop. That's why there's a Royal heavy-duty POWR-KORD to fit *every* job. Available in one quality (the very best) . . . two types (rubber and vinyl) . . . three colors (red, black, yellow) . . . four wire sizes (12, 14, 16, 18) . . . and over five handy cord lengths (10 to 100 ft.). See your wholesaler. He has the facts — and Royal POWR-KORDS in stock, ready for your work.

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DRY WASH

[FROM PAGE 121]

rider" basis. A few large jobs are also located as far away from home base as 400 miles, although general procedure then is to sub-contract actual work on these remote projects while handling supervision, contract signing and work schedules by home-office personnel.

In promoting business either through advertising (phone books and direct mail) or by personal calls on prospective customers, it is emphasized that (1) maximum light output can only be obtained through proper maintenance; (2) light output can be reduced by 50% or more by dirty lamps, reflectors or diffusing panels, flickering lamps, defective ballasts or starters; (3) maintenance by an organization specializing in such service is advantageous, because men and equipment are selected for reasons of efficiency and resulting economy; and that (4) when an "outside" organization is employed to maintain a lighting system, then "inside" manpower and supervisory personnel can be released for other work more directly related to a customers' product (whether that product is physical, mental or advisory).

A final word is in order to define the company's Lease-Lite tag, because it applies to a policy of easy financing, whereby customers are offered a pay-as-you-see arrangement. Financially sponsored by a leading lamp manufacturer, this policy permits customers to stock up on lamps, sign up for long-term maintenance, purchase new fixtures and accessories or improve their overall lighting system immediately. Yet the costs related to these benefits are billed as small monthly charges over periods that may range up to 26 months in duration.

This policy has advantages for customers and maintenance companies alike, because customers need not invest large initial payments to obtain prompt improvements in their lighting; they therefore can "see now, pay later," while maintenance companies can reduce their inventories and the related storage space problems.

This entire operation is attracting considerable attention in west-coast maintenance circles, because satisfied customers are "passing the word" that washing procedures need not be messy.

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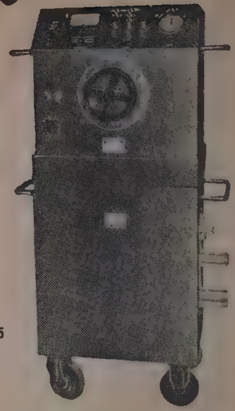
CIRCUIT BREAKER TESTERS



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Here's a modern, comprehensive reference and instruction manual on the methods and techniques used in constructing systems for power, light, signals and communications. Covering the best practice on selecting, mounting, connecting and housing all types of electrical equipment, **this manual presents *1959 National Electrical Code data* relating to installation. And a wealth of special illustrations are used throughout to clarify fine code points.**

Chapters are broken down on the basis of types of equipment to facilitate ready reference: lighting equipment — motors and controllers — conductors — raceways — switches — overcurrent protective devices — switchboards and panelboards — transformers — capacitors and regulators — power sources — high voltage — signals and communications.

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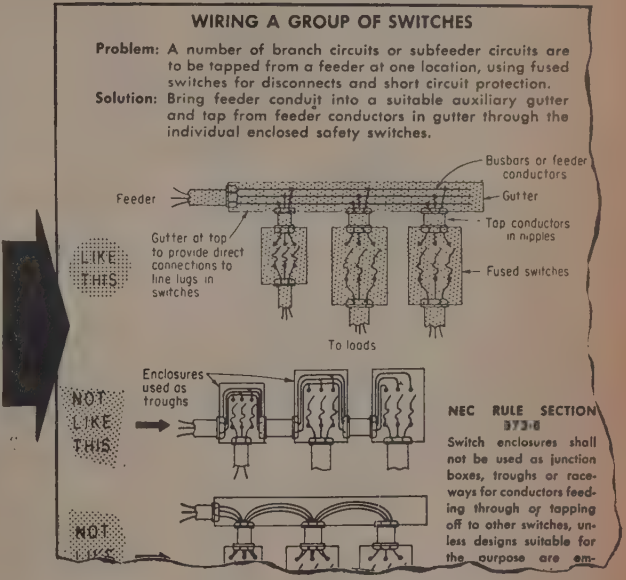

WIRING A GROUP OF SWITCHES

Problem: A number of branch circuits or subfeeder circuits are to be tapped from a feeder at one location, using fused switches for disconnects and short circuit protection.

Solution: Bring feeder conduit into a suitable auxiliary gutter and tap from feeder conductors in gutter through the individual enclosed safety switches.

NEC RULE SECTION 373-6

Switch enclosures shall not be used as junction boxes, troughs or raceways for conductors feeding through or tapping off to other switches, unless designs suitable for the purpose are em-

LIKE THIS
Feeder
Busbars or feeder conductors
Gutter
Top conductors in nipples
Gutter at top to provide direct connections to line lugs in switches
Fused switches
To loads
NOT LIKE THIS
Enclosures used as troughs
NOT LIKE

PLANT ELECTRICAL PEOPLE — This book should be in the reference library of plant electrical engineers, electrical supervisors and electricians.

ELECTRICAL INSPECTORS — Here's a unique presentation of code rules in combination with specific installation details taken from modern practice. The correlation between code generalities and actual job specifics will assist inspectors in many difficult rulings.

CONTENTS

General Considerations
Luminaires and
  Lighting Equipment
Motors and Controllers
Conductors
Raceways
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(273-076)

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steel —"Trouble Saver" Rolling Scaffolds are erected from simple, easy-to-assemble parts. End frames, 2′, 3′ or 5′ wide, are joined by pivoted diagonal braces to form the basic unit. Additional frames are placed on top of the original basic unit by means of sprockets.

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Among the Manufacturers

Headquarters Announcements

I-T-E Circuit Breaker Co., Philadelphia, Pa., has acquired all the outstanding capital stock of **Standard Electric Mfg. Co.**, Dallas, Texas.

Phelps Dodge Copper Products Corp., New York, N. Y., announced the acquisition of **Edlen, Inc.**, Bethesda, Md.

Atlas Lighting, Inc. has moved to enlarged offices and plant at 777 East Rosecrans Ave., Los Angeles, Calif.

Westinghouse Electric Corp., Pittsburgh, Pa.—William T. Rush, sales manager, standard control div., Beaver, Pa.; Charles E. Hammond, Central Pacific district manager, apparatus marketing.

National Elec. Div., H. K. Porter Co., Inc., Pittsburgh, Pa.—Edward S. J. McVickar, manager of mining and welding cable sales.

Appleton Electric Co., Chicago, Ill.—Murray J. Mauritzen, vice-president, manufacturing.

Euclid Equipment Inc., Freeport, L. I., N. Y.—William W. Pearsall, vice president and director.

Sylvania Electric Products Inc., New York, N. Y.—George C. Connor, vice president, marketing activities.

Cutler-Hammer, Inc., Milwaukee, Wis.—R. A. Millermaster, vice president, development.

Barkelew Electric Mfg. Co., Middletown, Ohio—Charles W. Wright, sales engineer.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.—R. C. Bown, manager of sales, control dept.; W. G. Williams, manager, Rectifier Section.

Wolverine Tube, Allen Park, Mich.—L. A. Brewer, manager of sales administration.

Vickers Inc., St. Louis, Mo.—Charles K. Apel, industrial controls sales manager, Electric Products Div.

Continental Electric Co., Cincinnati, Ohio—John A. Conners, assistant sales manager.

Permacel Div., Johnson & Johnson, New Brunswick, N. J.—George A. Fitzgerald, president; Robert S. Bradford, vice president, sales.

Alrectic Div., McGraw-Edison Co., Jackson, Mich.—Wesley J. Gorder, manager of sales and engineering.

Controls Co. of America, Schiller

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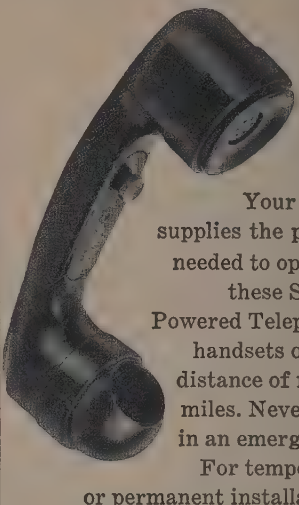
that need no current



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Park, Ill.—Joseph H. Schellman, vice president.

General Electric Co., Schenectady, N. Y.—Robert H. Smith, manager, manufacturing, Outdoor Lighting Dept.

Triangle Conduit & Cable Co., New Brunswick, N. J.—Raymond E. LaPlante, product manager, Fiber Products Div.

U. S. Industries, Inc., New York, N. Y.—T. ,Singelis, vice president, marketing services, Clearing Div.

Jefferson Electric Co., Bellwood, Ill.—Joseph A. Schneller, manager of new Technical Services Dept.

Erico Products, Inc., Cleveland, Ohio—Ed Langhenry, national sales manager for the Cadweld Electrical Connection Div., the Caddy Arc Welding Accessory Div. and the Caddy Toggle Clamp Div.

Stromberg, Div. of General Time Corp., Thomaston, Conn.—M. J. Dragich, general service manager.

Gould-National Batteries, Inc., St. Paul, Minn.—A. W. Brunsell, general sales manager, NICAD Div.

Sylvania Lighting Products, Salem, Mass.—James P. O'Brien, manager of equipment development.

Essex Wire Corp., Marion, Ind.—J. W. Mitchell, Paranite Products sales manager, Wire and Cable Div.

Fisher-Pierce Co., So. Braintree, Mass.—Edward V. Diercks, sales application engineer.

Milwaukee Crane Div., Novo Industrial Corp., Cudahy, Wis.—Edward A. Puchalski, sales manager.

Kaiser Aluminum & Chemical Sales, Inc., Oakland, Calif.—Neil K. Barr, technical manager, Electrical Conductor Div.

Minneapolis-Honeywell Regulator Co., Minneapolis, Min.—Kenneth Brierly, manager, Fall River, Mass. Division; John H. Hagen, manager, Rubicon Division.

Regional Appointments

NEW ENGLAND

Fisher-Pierce Co.: A. C. Stohn Associates, East Milton, Mass., sales representative for the six New England states.

Westinghouse Electric Corp.: Bruce W. Morrison, sales manager, Boston district office.

Allis-Chalmers Mfg. Co.: George G. Butenkoff, sales representative, Hartford district.

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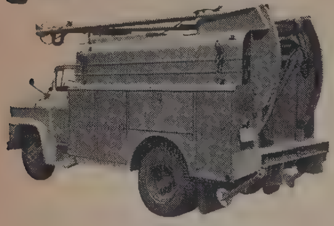

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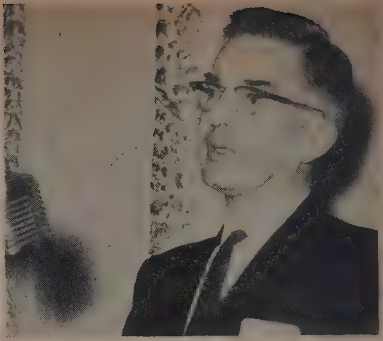

J. V. McBRIDE, chief engineer, The Plastic Wire & Cable Corp., tells Illinois electrical inspectors at Chicago conference that use of superlative insulations on conductors can lead to smaller cables, smaller raceways and better service reliability.

Jr., district sales engineer, New York City area.

Graybar Electric Co., Inc.: A. W. Hallett, manager at Allentown, Pa.

General Electric Co.: G. Stephen Glaser, sales representative of the eastern district, Silicone Products Dept., Newark, N. J.

Gould-National Batteries, Inc.: George P. Millington, Jr., central zone manager, Industrial Div., headquarters in Trenton, N. J.; Guy R. Porter, Jr., Atlantic regional manager, Industrial Div., headquarters in Philadelphia.

Wolverine Tube: F. J. O'Donnell, sales representative, headquarters in Long Island City, N. Y.

National Carbon Co.: John Gibb, mideastern division manager of brush and railroad products, headquarters in Pittsburgh.

Penn Controls, Inc.: John McCaffrey, manager, Philadelphia office.

SOUTH ATLANTIC

National Elec. Div., H. K. Porter Co., Inc.: H. E. Cole, Jr., district manager of Atlanta.

Square D Co.: S. T. Walz, southeastern region manager.

Wheatland Electric Products: Walter J. Barnes, southeastern sales manager.

Penn Controls, Inc.: Harold S. King, manager, Atlanta district sales office; Joseph B. Chomel, manager of new Washington, D. C., district office.

EAST CENTRAL

Western Insulated Wire Co.: Korak-Crossey Co., Chicago, Ill., Bronco sales representative in the Chicago Trading area, northern Illinois, and northern Indiana.

Line Material Industries: E. M. Gibbs, manager of Birmingham plant.

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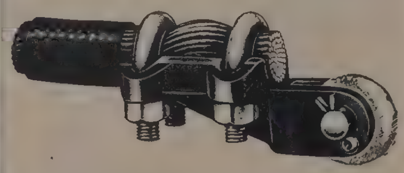

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Bohn Aluminum & Brass Corp.: Gerald H. Dettman, sales engineer, Chicago district.

Allis-Chalmers Mfg. Co.: Thomas A. Johnson, sales representative, Columbus district.

Penn Controls, Inc.: C. P. Pestow, manager, Chicago district; Elmer A. Rave, manager, Dayton district office; Robert T. McGrath, sales engineer, Milwaukee territory.

WEST CENTRAL

International Resistance Co.: Darrell V. Jarvis, marketing manager of the Burlington, Iowa, division.

C & D Batteries: David C. Gipson, sales representative, Houston, Texas area.

Virden Lighting: Walter C. Stadler, sales representative, Dallas and northeast Texas area; James O. Knight, sales representative, Fort Worth, north and west Texas area.

National Elec. Div., H. K. Porter Co., Inc.: J. D. Williams, branch manager, Houston.

American Super-Temperature Wires, Inc.: K. O. Brown Co. Dallas, Texas, manufacturers' representative in Texas.

WEST

International Register Co.: Charles M. Wellnitz, western regional sales manager, Distributor Products Div.

Halo Lighting Products, Inc.: John Cummings, California district sales manager, headquarters in Los Angeles.

Federal Pacific Electric Co.: C. H. Brittenham, manufacturing manager, Pacific manufacturing division, headquarters in Santa Clara, Calif.

General Electric Co.: W. W. Smith, manager, California plant, Distribution Assemblies Dept.

The Electric Autolite Co.: Irving P. Siminoff, western district manager, Electrical Products Div.

National Elec. Div., H. K. Porter Co., Inc.: Emery E. Dwyer, branch manager of San Francisco.

The National Supply Co.: Northwestern Agencies, Seattle, Wash., conduit and underfloor duct representative.

Harvey Aluminum: Don Fullerton, district sales manager in Portland, Oregon.

Multi-Amp Electronic Corp.: Honolulu Electrical Products Co., Ltd., representative in Hawaii.

Western Insulated Wire Co.: Electrorep, Inc., San Francisco, Calif., Bronco sales representative in northern California.

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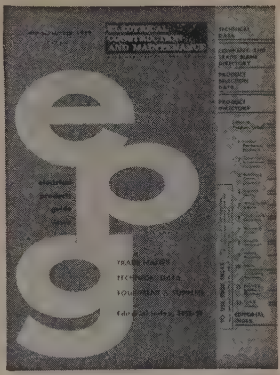

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Heating & Cooling Equip.
Tools & Supplies

4. TECHNICAL DATA AND REFERENCE MATERIAL
Covers electrical symbols, diagrams, definitions, tables, formulas, and practical calculations used in electrical construction.

* Subscribers received the Mid-September 1960 EPG as part of their regular service. A few extra copies are still available—when they are gone no more will be printed until next year's edition. Order several copies for your office and staff—only $2.50 per copy.

ELECTRICAL PRODUCTS GUIDE Issue
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MILE-LONG BUS COMPLEX

[FROM PAGE 87]

of the spirally laid triplex design. (2) Current-carrying capacity of three single-conductors in one duct (compared to a 3/c cable having corresponding conductor and voltage ratings) would be proportionally increased. (3) Splicing operations in manholes would be simplified and less expensive. In fact, in those cases where 3- and 4-way splice points exist (tap-offs for transformer vaults), it would be quite impractical to make such splices with 3/c 500 MCM cable, since this procedure would necessitate auxiliary bussing to permit the establishment of necessary 1/c taps. In addition to this installation complication, it is apparent that physical congestion in manholes would be correspondingly multiplied.

Between manhole taps and transformer vaults, conductors were installed as individual cables because, since each conductor was of a different length, the triplex form would not have resulted in economical cutting. All exposed cables (in manholes and vaults alike) were fireproofed after grouping by butt-wrapping with Niagrite A tape (water-soaked before applying) in addition to half-lap asbestos tape on top.

Manholes located along the underground primary route are of reinforced concrete having interior dimensions approximating 7½-ft cubes, and equipped with corner drainage sumps, 32-in. manhole covers, also pulling irons embedded in walls opposite all duct-bank entrance points.

Primary Duct Bank

The main primary-distribution duct bank, consisting of six 4½-in. cellulous-fiber coal-tar-impregnated ducts, is concrete-sheathed to form a unified assembly. Cellulous fiber ducts were selected due to their high dielectric strength and resistance to corrosion, heat, water and deleterious soil conditions. Moreover, since speed of installation was a major factor, the contractor looked with favor upon the duct's light weight (resulting in handling ease) and smooth inside bore (which facilitated fast pulling-in

How to
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wiring and
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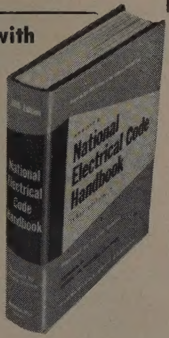
in strict accordance with the 1959 National Electrical Code



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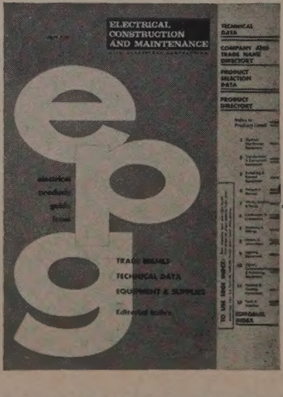
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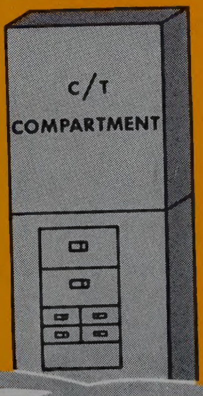

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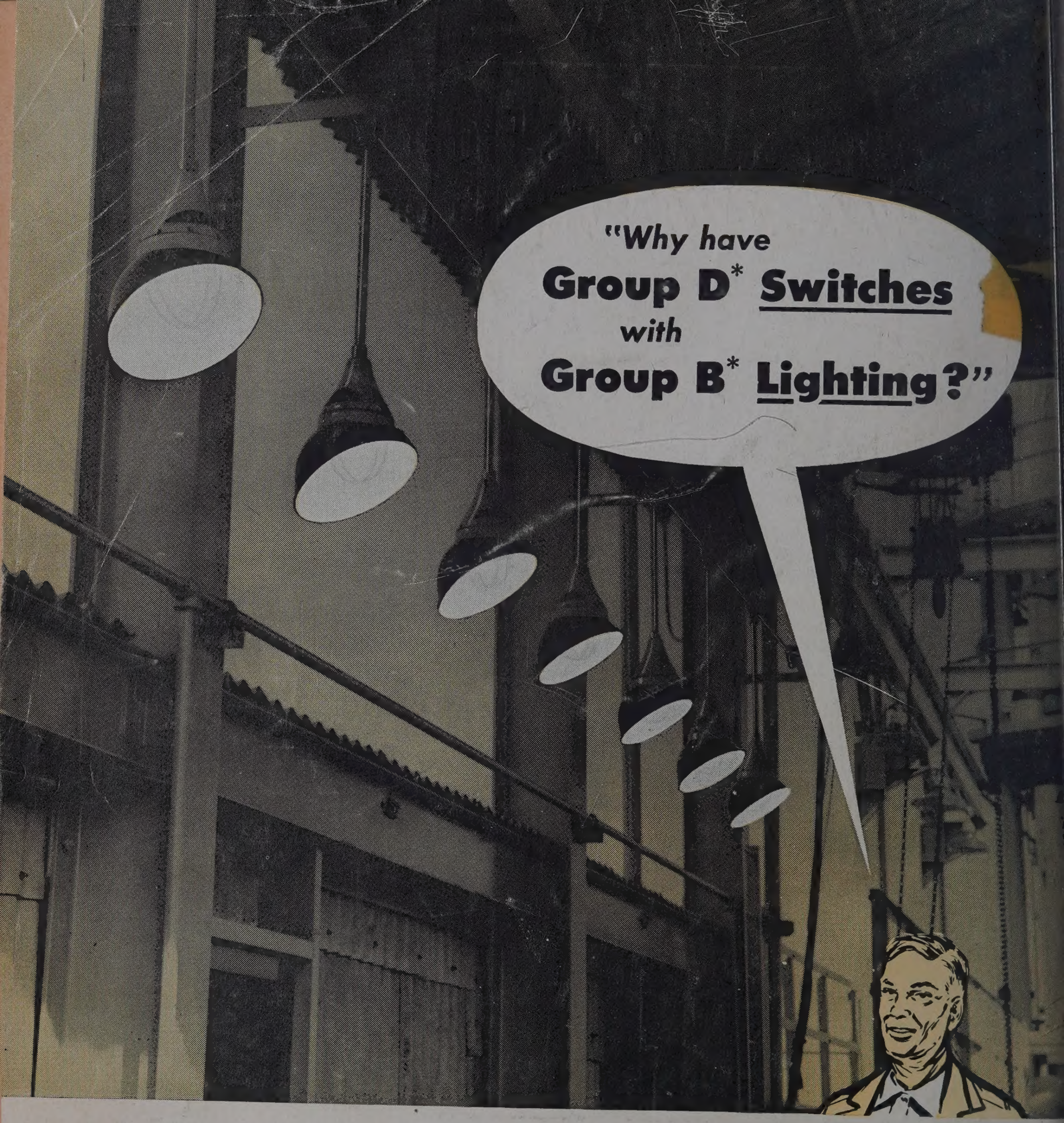

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